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**NEWS BULLETIN**

**CONTENTS**

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rest efficacy and extraction of that living intellect that bred them.

—John Milton

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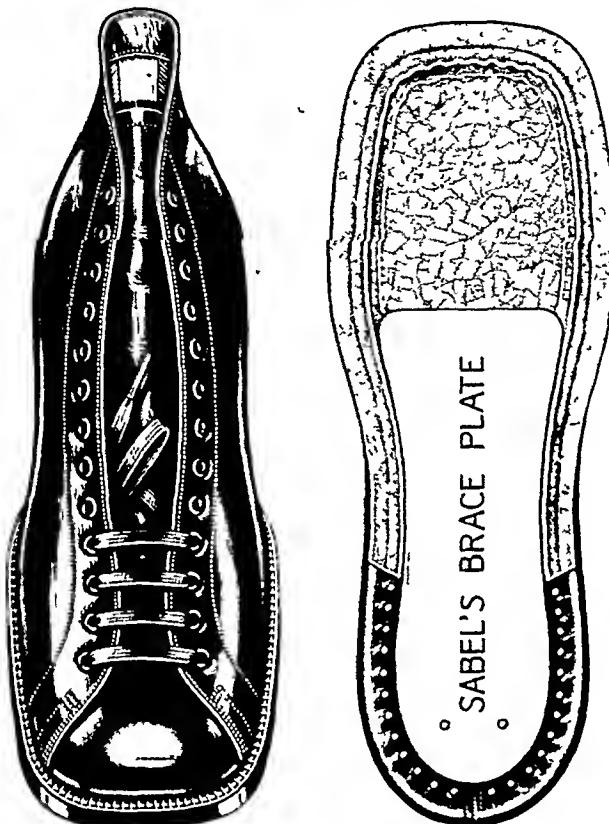
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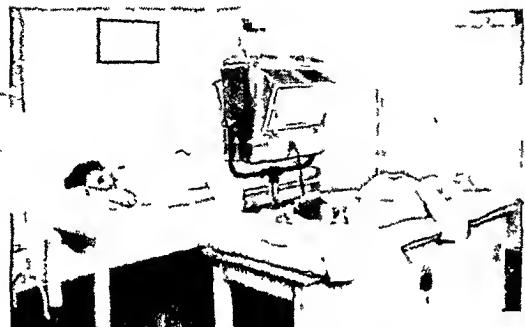
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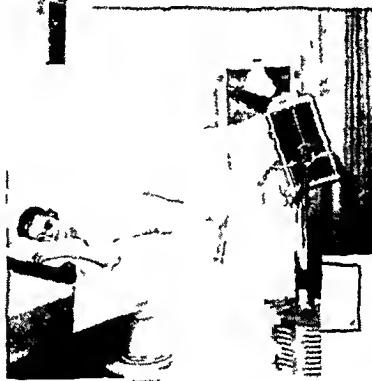
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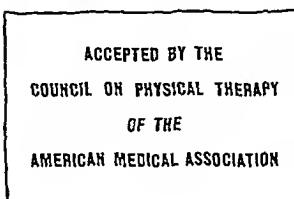
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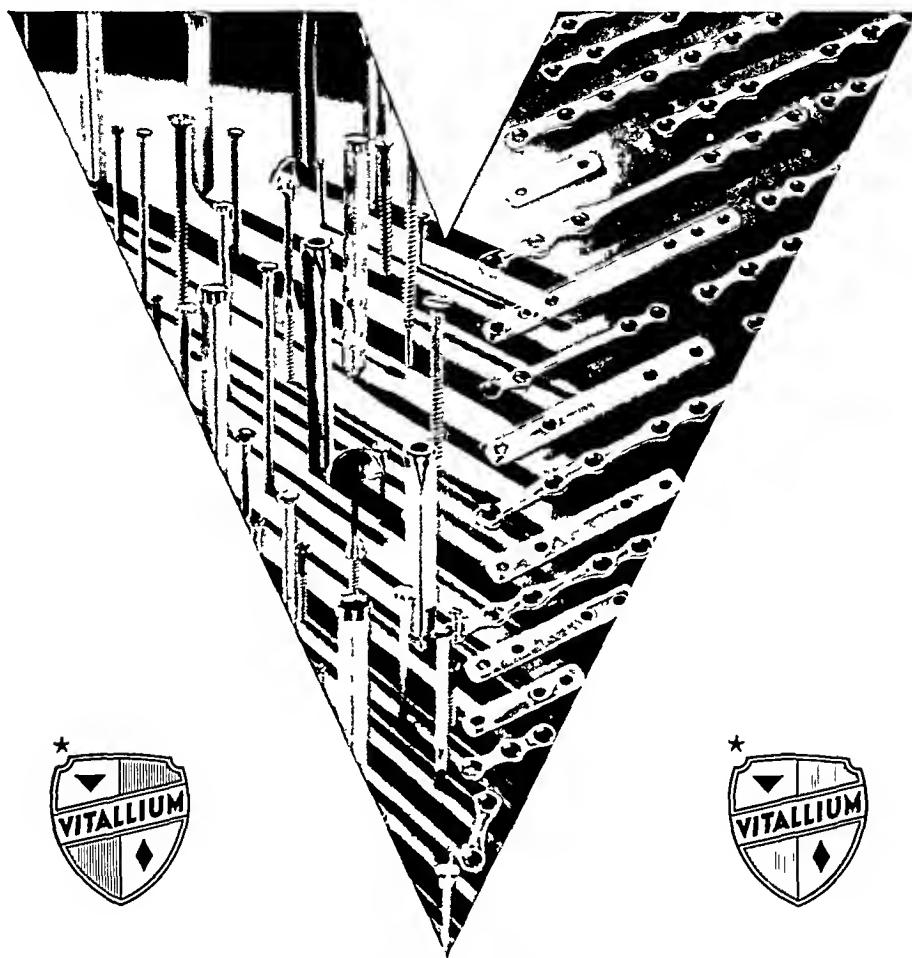
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\*\*\* Venable, Stuck and Beach, Trans. Southern Surgical Assn., Vol. 49, 1937.

Venable and Stuck, Journal of Indiana Medical Assn., Vol. 31, July, 1938.

Hopkins and Zuck, Medical Bulletin of the Veterans' Admin., Vol. 15, July, 1938.

Venable and Stuck, Journal of American Medical Assn., Vol. 111, No. 15, Oct. 1938.

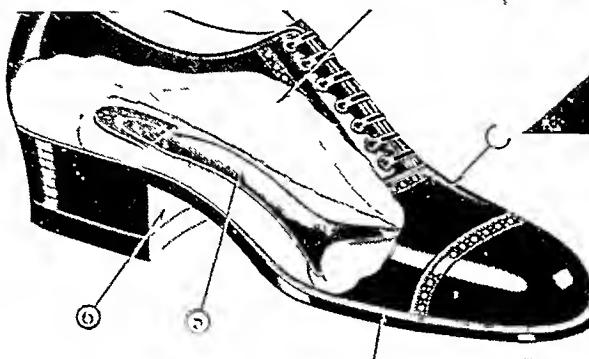
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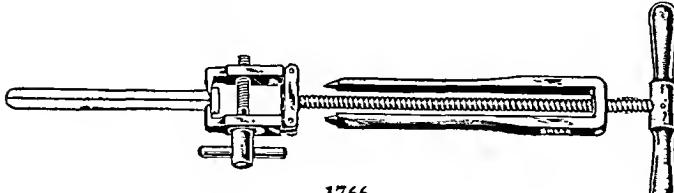
S-1765 $\frac{3}{4}$  — Smith-Petersen's Stainless Steel Hip Nails but with threaded hole in head  $\frac{1}{4}'' \times 20$  to fit instruments Nos. 1770 and 1771.

S-1765 — Smith-Petersen's Stainless Steel Hip Nails. Solid with small hole off-center in head for Kirschner wire guide 3 sizes, 9 $\frac{1}{2}$  cm., 10 $\frac{1}{2}$  cm., or 11 $\frac{1}{2}$  cm.

S-1765 $\frac{1}{4}$  — Smith-Petersen's Stainless Steel Hip Nails. Same as S-1765, but with threaded hole in head  $\frac{1}{4}'' \times 20$ , to fit Nos. 1770 and 1771.



S-1765 $\frac{1}{2}$  — S-1765 $\frac{3}{4}$



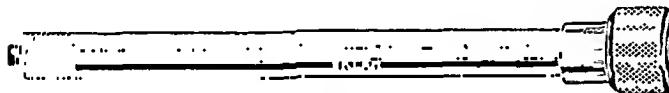
1766

1766 — Smith-Petersen's Nail Extractor. To be used on all Smith-Petersen's hip nails with or without canula and when head of nail and part of shaft are exposed. Forged steel, chrome-plated.



1768

1768 — Smith-Petersen's Nail Set. Used to drive Smith-Petersen's nails without removal of wire drill. Canula entire length to fit  $\frac{1}{16}''$  wire drill. Steel forged, chrome-plated.



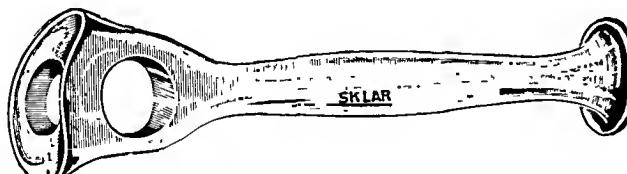
1770

1770 — Eric Lloyd's Introducer for Smith-Petersen's Nails. End is threaded  $\frac{1}{4}'' \times 20$  to fit nails Nos. 1765 $\frac{3}{4}$  or 1765 $\frac{1}{4}$ .



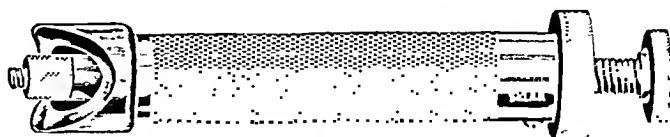
1767

1767 — Smith-Petersen's Nail Starter. One of three blades elongated to prevent slipping. Forged steel, chrome-plated.



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1769 — Smith-Petersen's Impactor. Used to approximate the fragments after nail is driven into position. Fits over head of nail so that force of blow is transmitted directly to cortex of femur in the subtrochanteric region. Made of bronze, chrome-plated.



1771

1771 — Eric Lloyd's Extractor for use with Smith-Petersen's Nails, which have threaded hole in head  $\frac{1}{4}'' \times 20$ , when head of nail and part of shaft are not exposed. Made of steel, chrome-plated.

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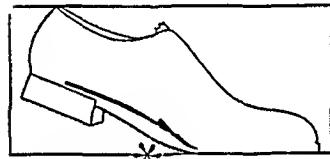
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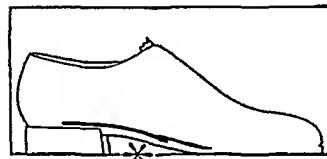
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FIG. 1-A

Dog with femur plated with Vitallium Hawley Plate, seven days after operation. Dog began walking second day after operation. X-ray taken seventh day after operation.

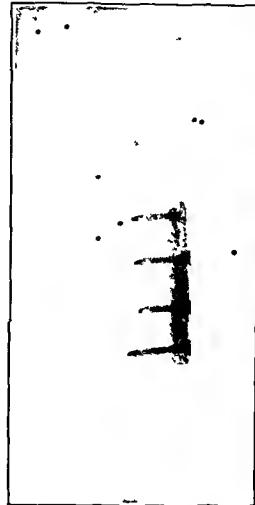


FIG. 1-B

*From experiments conducted at Yale University*



FIG. 2-A

Dog with femur plated with Vitallium flat plate, seven days after operation. Dog did not put foot to floor after operation. X-ray taken seventh day showing plate bent.

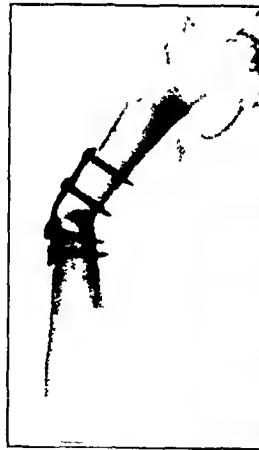


FIG. 2-B

NOTE: Surgeons can have confidence that this plate will not bend or break. Experienced surgeons find its application easy because the slot holds the plate while the screws are introduced. The slot is made by the thin circular saw of the Albee bone set. (See description by Dr. George W. Hawley and Dr. Ralph D. Padula in *The Journal of Bone and Joint Surgery*, XX, 469, April 1938.)

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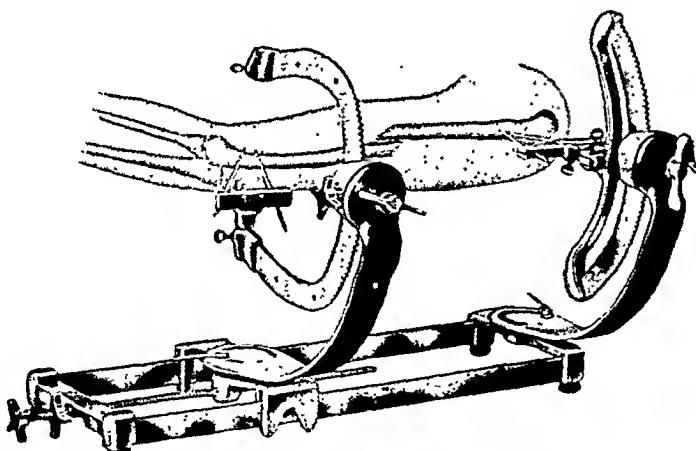
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VOLUME XXI  
OLD SERIES - VOLUME XXXVII

1939



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*The Official Publication of the*  
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British Orthopaedic Association  
American Academy of Orthopaedic Surgeons  
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THE JOURNAL OF BONE AND JOINT SURGERY

8 The Fenway, Boston, Massachusetts, U. S. A.



# The Journal of Bone and Joint Surgery

## OSTEO-ARTHRITIS OF THE HIP JOINT \*

BY T. P. MCMURRAY, M.CH., F.R.C.S., LIVERPOOL, ENGLAND

*Director of Orthopaedics and Lecturer in Orthopaedic Surgery, Liverpool University;  
Honorary Orthopaedic Surgeon, David Lewis Northern Hospital*

The attempts to agree on the best classification of non-specific arthritis of the hip joint have led to a vast amount of discussion, but as yet to no general agreement. A mass of terminology, based on the symptoms, signs, or possible causes of the disease, has arisen, but each new definition falls short in some essential feature and is open to a variety of exceptions, so that no scheme can, as yet, be described as ideal. Clinically, the outstanding feature of the condition is the gradual diminution of the range of movement in the affected joint. As a rule, the limitation is at first painless, but later, with further restriction, great pain may be experienced.

### TYPES

From a clinical point of view, osteo-arthritis of the hip can be divided easily into two groups:

1. Unilateral.
2. Bilateral.

#### *Unilateral*

In this group, there are two distinct subsections, the appreciation of which is essential for the provision of the most suitable form of treatment.

The first subgroup is composed of those patients in whom the pathological changes have followed either an alteration in the mechanical relationship between the head of the femur and the acetabulum or a single severe injury to the articular surfaces. Such alterations in the normal mechanics are commonly seen in congenital dislocation, in subluxation of the hip joint, and following Legg-Perthes disease, in each of which weight-bearing through the hip joint is concentrated on a comparatively small area of the articular cartilage.

\* Read by invitation at the Annual Meeting of the American Orthopaedic Association, Atlantic City, New Jersey, May 4, 1938.

The second subdivision of this first or unilateral group consists of those patients in whom osteo-arthritis changes have developed in one hip joint, and yet no simple mechanical influence or traumatic history can be adduced as a cause of the disease. The onset is very similar to that of the first group, being characterized by a gradually increasing stiffness of the joint, which causes difficulty in performing some simple movement, such as putting on a sock or crossing the affected leg over the other. Gradually the stiffness increases, and the patient begins to complain of aching in the thigh and over the buttock. In the early stages, the roentgenogram may show only a trace of lipping, but, as the disease progresses, these changes increase until the fully formed osteo-arthritis outgrowths become evident.

It is usually impossible to decide on the cause of the arthritis. Focal sepsis, infection of a sinus, or chronic constipation may be suggested, but, in most instances, the surgeon will find difficulty in satisfying himself as to the importance of such sources of infection.

The recognition of the existence of this group of patients is of the utmost clinical importance. The problems to be faced are vastly different from those in cases in which the onset of the disease can be attributed to mechanical alterations. The reason is quite obvious. If osteo-arthritis develops in one hip without any obvious traumatic or mechanical cause, then it is clear that a similar change may follow in the other hip, a possibility which must modify our views as to the most suitable form of operative interference.

### *Bilateral*

In this group, the joint changes are present on both sides and can only occasionally be attributed to trauma, although the disease may follow congenital or acquired alterations in the structure of the joint cavities. The outstanding clinical feature in these patients is that, although present on both sides, the changes are rarely equal in extent or in their rate of progress, and in many instances the existence of osteo-arthritis on the less affected side remains unrecognized for a considerable period.

### SEQUELAE

With the development of arthritic changes in the hip, the first effect, from the mechanical point of view, must be a diminution in the range of movement. As the joint changes become more advanced, the restriction increases until eventually all active movement may be lost, although there is always present a small range of passive movement, which may be extremely painful. If a patient suffering from such a limitation of movement in the hip is to continue to lead an active life, the loss of movement must be replaced to some extent by an increased range of motion in other associated joints.

In walking or in sitting, partial or complete loss of movement in the hip joint can be replaced to some extent by an abnormally free range of

movement in the lumbar spine, so that with slight limitation of movement in the hip there may be little apparent alteration of function. As the range of movement in the hip diminishes, the compensatory movement in the lumbar spine must be increased, until a point is reached at which further compensatory increase in the spine is impossible, and it is evident that the full range of movement is not present. The extent of this compensation naturally depends on the condition of the lumbar spine. In a child or adolescent, even complete ankylosis of the hip may cause comparatively little inconvenience, and may be hard to detect. In the adult, or in the aged, such complete compensation is impossible, due to rigidity of the soft tissues, and probably also to the presence of arthritic changes on the vertebral margins.

#### TREATMENT

The success of treatment of any particular disease depends largely on the extent of our knowledge as to its cause. When this is known, attempts at its cure can be scientifically organized; but in a disease such as osteo-arthritis, the cause of which is as yet unknown, no such plan can be employed. Just as the theories in regard to the cause of the disease are legion, so are the suggested lines of treatment. In an attempt to classify the forms of treatment in general use, we may divide them into the following groups.

#### *Elimination of Infective Processes*

The first, which aims at the elimination of infective processes, includes the clearing out of local collections of infective material by the removal of septic teeth, tonsils, etc., or the opening up of infected sinuses. When complete removal is impossible, vaccines and sera may be tried, but unfortunately this method has proved disappointing in many apparently suitable cases. Occasionally, the removal of an obvious source of infection has been followed by dramatic improvement, but even in these rare instances the removal of the cause does not always stop the progress of the disease, nor does it change the arthritic joint into a normal joint.

#### *Physiotherapy*

Massage, radiant heat, ionization, ultra-violet light, and numerous other forms of physiotherapy all have their advocates, and, in a small percentage of patients, the use of one or another of these results in a diminution of symptoms. The great drawback to their use is their essential unreliability. In one patient, ionization produces considerable relief; while in another, with apparently similar symptoms and signs, its use only aggravates the condition and increases the discomfort. As a rule, it is found that radiant heat is the most generally satisfactory; most patients agree that during its application, and for an hour or two afterward, the joint feels more comfortable and freer, but gradually the previous sensations and the feeling of stiffness return.

### *Manipulation*

The advisability of the use of manipulation in the treatment of infective conditions in a joint has been questioned. If it were true that this type of chronic arthritis is caused by the presence of bacteria in an inflamed and swollen joint, then the value of manipulation as a therapeutic measure would be more than doubtful. The condition is not, however, an acute infection, but rather a subacute inflammation of the lining of the joint, the cause of which may possibly become eliminated, either spontaneously or as the result of treatment.

It is quite obvious that in the presence of active inflammatory changes manipulation would almost certainly increase the rapidity of destruction, but if the causative infection has been arrested, or if the progress is especially slow, then gentle manipulation of such a joint can produce a definite increase in movements, and may lead to at least a temporary diminution of discomfort or pain.

Manipulation has a place in the treatment of early osteo-arthritis, but that place must be very carefully defined, or considerable harm may follow its use. It is of value primarily in those patients suffering from osteoarthritis which has followed a mechanical alteration of the articular surfaces, especially when only one movement of the joint is diminished in range.

If the manipulation is performed under anaesthesia, the joint is put through that movement which was previously difficult or impossible. The movements must be gentle, for, if a vigorous wrenching of the joint is employed, the other movements (which were previously free) will probably be diminished or lost as a result of the unnecessary trauma.

If carried out gently in a suitable case, manipulation is usually followed by a very definite period of relief with an increased range of movements, and the patient is convinced that all is well. Unfortunately, the relief is only temporary, lasting as a rule from one to two years, but during that time greater freedom is present in the joint, and efforts to combat the infective process may be continued.

As soon as the disease has advanced beyond this early stage and the limitation of movement has become general, and when the roentgenographic appearance indicates the presence of outgrowths around the head of the femur and the acetabulum, then the time for manipulation of the joint has passed. Forced movement at this stage, either with or without anaesthesia, only produces inflammation, swelling, tenderness, and pain; and, as in any other inflamed joint, rest must be employed as the chief factor in the reduction of such inflammation.

### *Rest*

At the stage of the disease when the range of movement is restricted in every direction, rest of the affected joint for a period of three or four months results in a reduction of the tenderness and aching, and frequently also in a perceptible increase in the range of movement. Sufficient rest

can be given to the joint by the use of a plaster spica, extending from the pelvis to just above the knee joint. As a rule, the results of this form of treatment are satisfactory. In many instances no further treatment is necessary; the patients are relieved of symptoms and are enabled to carry on for many years without difficulty. In other cases, after a temporary relief, the pain returns, with a gradually increasing restriction of movement, which demands some more radical type of treatment.

#### DISCUSSION

The author believes that it will be easier to arrive at some conclusions in regard to the solution of these problems if they are carefully considered under separate headings.

##### *Unilateral Type*

The first subgroup which has been suggested presents a problem which is comparatively uncomplicated. This group consists of the patients in whom, on account of some malformation, or following a direct trauma to the joint, a condition of unilateral osteo-arthritis has developed. The other hip and the lumbar spine show no traces of disease, and have a normal or, in fact, sometimes a definitely increased range of movement.

The problems here seem to be comparatively simple. The patient is usually fairly young, and is suffering from rigidity of one hip joint. It is generally agreed that, when the movement of any joint is limited, the ideal treatment must be the restoration of that joint to its full range of painless stable motion, if this is possible. Unfortunately no treatment hitherto adopted—either medical or surgical—has been successful in producing this ideal result. Arthroplasties and pseudarthroses of many types have been suggested and tried over the past fifty years, but they all fail in some important feature. Following the use of one method, although the movement is free and painless, stability is very greatly reduced. By means of another, although the stability remains unimpaired, movement is gravely diminished and may be painful. We are, therefore, forced to adopt some other procedure that gives promise of producing a joint which is at least painless and stable,—the two most important factors in the hip joint. Such a result will follow a successful arthrodesis of the hip, and such an operation is justifiable in unilateral osteo-arthritis, if there is no other method by which a stable joint can be procured.

There are, however, certain definite objections to the operation of arthrodesis of the hip joint. Illustrative of this are the following histories of two patients suffering from osteo-arthritis, whose hips were arthrodesed by the author eighteen years ago.

CASE 1. A woman, aged thirty-one, suffered from a painful arthritis of the hip, which had followed a condition of Legg-Perthes disease in childhood. On account of the acute pain, the hip was arthrodesed, and the operation resulted in the formation of a bony ankylosis. Twelve months later, the patient was apparently perfectly well and was

able to walk miles without pain or discomfort. In the record of her case, the operation was naturally put down as a success. Ten years later, at the age of forty-two, the patient returned, saying that the hip joint gave no trouble, but that she had constant severe aching and pain in the lower lumbar region, which was increased by use and diminished by rest. Roentgenographic examination showed sound bony ankylosis of the hip with very early arthritic changes in the lumbar spine.

CASE 2. A man, aged fifty-three, suffering from osteo-arthritis of one hip, showed by clinical and roentgenographic examinations no trace of osteo-arthritis in the other hip or in the lumbar spine. In his case also, the operation of arthrodesis was successfully performed, and he was completely relieved of all symptoms for a period of five years, during which he was able to carry on his normal work. He returned after that interval, complaining of pain and aching in the back. Further roentgenograms in this case also showed early osteo-arthritic changes, involving the lumbar spine and the other hip joint.

These two cases illustrate the problems which confront us in our efforts to relieve the patient's disability, and indicate the advisability of retaining some movement in the joint, if this be possible.

The second subgroup is formed of those patients in whom osteo-arthritis of one hip develops, with apparently no distinct history of injury and with no mechanical abnormality of the femoral head or acetabulum to account for the onset of the disease. These patients present an entirely different problem. In the first group, in which the arthritis followed a definite mechanical disturbance, it was evident that the arthritic change was induced by the mechanical alterations in the head and acetabulum; while in this second group, the condition arose as the result of infective or metabolic changes. If this is so, then it is evident that the process will not cease with the ankylosing of one hip, and it is probable that other joints, which are now normal, will become affected at a later date. In this group the contra-indications to any form of treatment which aims at ankylosis of the affected joint cannot be ignored, and every effort should be made to retain movement in the joint, so that the spine and the other hip may not be unduly strained.

#### *Bilateral Type*

In the third group, consisting of patients suffering from osteo-arthritis of both hips without mechanical cause, there can be no doubt that the pathological change has been instigated or stimulated by some general infection. In these patients, as a rule, one hip is more limited or more painful than the other. Occasionally, both hips are at approximately the same stage and show an apparently equal limitation,—a circumstance which must seriously affect our decision as to treatment.

#### PROBLEMS IN TREATMENT

These points should be borne in mind, so that, when examining the patient, the surgeon will not think only of the one painful or painless ankylosed joint. The difficulties to be faced are many, and the author's experience with the following questions may be helpful.

*First*, is it possible by any form of treatment—either medical or sur-

gical—to restore the normal painless range of stable movement in the affected joint?

The writer's experience with this disease has been that a complete restoration of function is impossible with any form of treatment, and that the osteophytic outgrowths around the affected hip never disappear, even though an improvement in function may, in some cases, be produced by physiotherapy.

*Second,* is the operation of arthrodesis of the affected hip ever justifiable?

The answer to this question must depend on many factors, of which the most important are the age of the patient and the condition of the neighboring joints. In comparatively young patients, in whom the osteo-arthritis has followed some undoubted mechanical defect of the hip, the operation is justifiable; the patient is restored to active life, and a greater than normal range of movement develops in the lumbar spine. In the older patients, or in those in whom the arthritis cannot be attributed definitely to alterations in structure, the operation is always inadvisable, even though it gives the patient temporary relief and freedom from symptoms.

Again, when the disease affects both hips, the primary object of treatment should be the provision of some movement, without which the patient becomes a complete cripple.

If, then, it is not possible to produce a freely moving, painless, strong joint, or if it is agreed that arthrodesis is an operation which may be used only in selected cases, what other form of treatment can be suggested?

#### OBLIQUE OSTEOTOMY

For this condition of osteo-arthritis, the author has, during the past ten years, used the operation of oblique osteotomy in forty-two instances. By this procedure (Figs. 1 and 2), after division of the shaft of the bone, the upper sharp end of the shaft of the femur is transferred inward until its upper inner border lies directly under the cotyloid ligament of the acetabulum.

The operation is performed with two objects in view: first, the transference of some of the body weight from the pelvis directly through the shaft of the femur, thus relieving the hip joint; and, second, the rotation of the head of the femur, so that in weight-bearing a new portion of the articular surface takes the remaining weight.

#### *Operative Technique*

The femur is approached through a six-inch vertical incision on the outer side of the upper portion of the shaft. After the muscle attachments have been stripped from the front of the shaft and the neck of the femur, so that the exact relationship may be appreciated, the bone is divided in an oblique line at an angle of 40 degrees, so planned that the upper end of the osteotomy lies between the lesser trochanter and the neck of the femur. The osteotomy must be complete, so that splintering

does not occur. After the two fragments are separated, the lower fragment is displaced inward until its upper margin lies directly under the cotyloid ligament of the hip joint. If this displacement is not sufficient, there can at best be only a partial relief of symptoms and a disappointing result. At first, a gap is left between the divided surfaces of the two fragments, but gradually this space becomes obliterated by the rotation inward of the lower end of the upper fragment, which is pulled in this direction by the muscles which have a common attachment to both fragments.

#### *Treatment of Fracture*

The fracture is then treated by fixation of the hip, thigh, and leg in a long plaster-of-Paris spica, with the limb in 20 degrees of abduction, and with the knee and hip flexed to 25 degrees, thereby preventing any strain on either joint. This position of abduction is retained for two and one-half weeks. The cast is then removed, the stitches are taken out, and a new plaster spica is applied, this time with the limb in the neutral position and the hip and knee again in slight flexion. This point of fixation of the limb in the neutral position during the period of union is of great importance. If the limb is maintained even in slight abduction, an ugly knock-knee deformity develops after removal of the cast. Fixation is continued for a period of three and one-half months until bony union is complete. Soundness of this union is essential, and no advantage is gained by reduction of the period of immobilization.

Movements of the joint are restored by exercises and massage, which

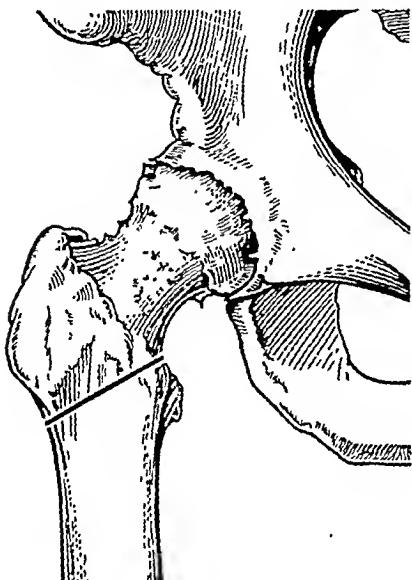


FIG. 1

Oblique osteotomy, showing site of osteotomy. (Courtesy of Edward Arnold & Co.<sup>1</sup>)

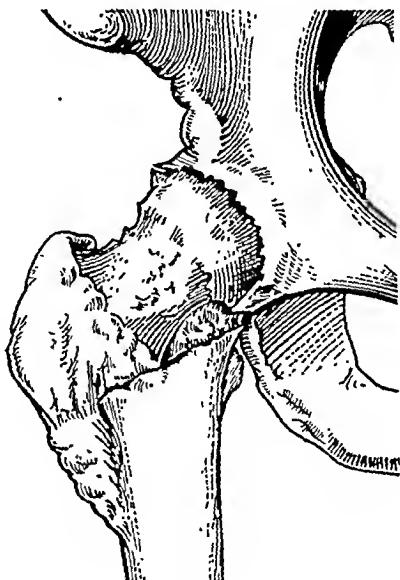


FIG. 2

Showing position of fragments after successful oblique osteotomy. (Courtesy of Edward Arnold & Co.<sup>1</sup>)

are employed for a period varying from three weeks to three months. There is usually no great difficulty in restoring movements in the knee, if the joint has not been fixed in full extension, but, if this error has been made, there may be a permanent loss of part of the normal range.

### *End Result*

If the operation is carried out correctly (Fig. 3), we may confidently expect the complete relief of even the most painful joint, the correction of the alignment of the limb, and the retention of at least 50 per cent. of the



FIG. 3

Roentgenogram showing end result of successful oblique osteotomy.  
(Courtesy of Edward Arnold & Co.<sup>1</sup>)

movement which was present in the joint before the operation. This latter may seem to be of little importance, but even a trace of painless movement is of the very greatest importance in relieving the strain which would otherwise be thrown on the neighboring joints.

### *Errors in Technique*

It would probably be helpful if the author enumerated the mistakes which he has made while performing this operation. The most common of these was the incomplete transference of the shaft of the femur after the osteotomy. In the first twelve or fifteen cases, a small skin incision—just sufficient to allow the entry of the osteotome—was used. After the division of the bone, the displacement was carried out subcutaneously, so

that it was not possible to see the fragments in their new position. This error has since been corrected by making a long incision—six or seven inches in length—through which the whole procedure can be completed, and the surgeon can satisfy himself as to the altered position of the fragments.

A second mistake was caused by using the same plan of operation through a small skin opening. On two occasions, the osteotomy line passed through the neck and emerged on its upper surface, so that the greater trochanter was simply divided from the remainder of the bone. In two other instances, the osteotomy was made too low, being below the level of the lesser trochanter, and the displacement which was then necessary led to excessive shortening of the limb and a considerable delay in union, as the rough surfaces had been so widely separated.

Full vision of the site of the osteotomy and of the new position into which the femoral head is displaced must be obtained, and only by seeing the lesser trochanter and the neck of the femur can the surgeon satisfy himself that the osteotomy is in the correct position.

One other error which can be made in this form of treatment is to be found in the fixation of the joint in the plaster cast in a position of full extension or hyperextension. If this position is adopted, the upper end of the lower fragment will slip forward and will lie in front of the upper fragment, producing a mechanical block to flexion and an inability to assume the sitting position. This can be easily guarded against by placing the hip in flexion at an angle of at least 25 degrees, so that the shaft may retain the desired position under the head of the femur and the acetabulum. In no case has the author found any tendency for the shaft to slip too far back, so that the position of flexion of the joint is quite safe.

These may seem to be small points, but they are all of importance if this method of treatment is to be used.

The obliquity of the line of the osteotomy is also of importance. If a transverse incision is made through the bone, the rough surface of the lower fragment will be displaced against the lower border of the head and neck of the femur, leaving no point of contact between the two divided surfaces, and tending to the production of non-union at the site of fracture.

After division of the bone, the transference of the lower fragment inward on the upper fragment is easily accomplished by rotation of the leg, which completes the separation of the fragments, and by abduction of the limb.

The rather prolonged fixation of a knee in which osteo-arthritis changes are already present may cause troublesome stiffness following the resumption of activity. This complication was encountered in several of the author's early cases, and apparently the cause of the rigidity lay in the position of fixation of the joint. Even in an advanced case of osteoarthritis, permanent rigidity does not develop in the knee after this period of fixation if the position of slight flexion is maintained. Occasionally

stiffness of the knee is complained of for some months after the removal of the plaster, but the writer has not seen any case in which mobility could not be restored by physiotherapy.

#### ADVANTAGES OF OSTEOTOMY

In summarizing the advantages which the author has found in this form of treatment, he would place them in the following order:

##### *Lessened Operative Shock*

Operation on the hip joint in an elderly patient causes a considerable amount of shock when it involves opening the joint, and especially removal of the head of the femur from the acetabulum. A record of the blood pressure taken during the course of such an operation demonstrates a very definite fall of from 20 to 30 per cent. at the moment when the head of the femur is removed from the acetabulum. If the operation is confined to the tissues around the joint, no such severe general reaction occurs, and such a procedure can be carried out without risk, even in weak elderly patients.

##### *Saving of Operating Time*

Prolonged operations are not well borne by these elderly patients. Osteotomy of the femur can be performed easily in from ten to fifteen minutes, a point which is of considerable importance in deciding on the most suitable procedure.

1. McMURRAY, T. P.: *A Practice of Orthopaedic Surgery.* London, Edward Arnold & Co., 1937.



true cause has been found.\* Let us review quickly, refuting them one after the other, the reasons previously expressed to explain the coxalgic gait.

### *Shortening*

Is shortening the cause? No, and chiefly for the following reasons:

1. A sufficiently large number of coxalgic patients are cured with the affected limb the same length as the other. There is no shortening, but, nevertheless, these patients limp and often limp more than others affected with marked shortening.

2. The correction of the shortening results in no appreciable modification of the limp. This correction is always easy, whether it be by a high shoe, or by surgical intervention (lengthening of the affected leg or shortening of the sound leg), or by a special attitude of the patient, such as walking with the foot in equinus or walking with the knee on the sound side permanently flexed. Certainly we do not wish to state that there is no limp inherent in a case of marked shortening. However, patients with shortening following fractures of the thigh do not commence to limp until there is shortening amounting to three or four centimeters. Up to that amount, a compensatory attitude permits correction of the shortening automatically and without a limp. With shortening of over four centimeters, at each step, when the shortened leg becomes weight-bearing, the body dips in some degree on this side, in the same manner as it does in a well person when he descends a staircase. It is the same movement of changing levels. It is well understood that this gait disappears when equality in the lengths of the legs is reestablished. Let us take for example a young woman walking in a slipper with a Louis Fifteenth heel on one foot and a slipper without a heel on the other. Her plunging gait disappears when she replaces the slipper without a heel with a slipper having a Louis Fifteenth heel. Now, in the case of coxalgic patients who limp in the fashion described—that is, with the oscillation of the shoulders and the characteristic rhythm—even when equal length in the two legs has been restored by some procedure, the limp in its entirety is only slightly modified and the two characteristic signs of the coxalgic gait persist.

### *Ankylosis*

Is ankylosis, either complete or incomplete, the cause of the coxalgic gait?

Since mobility is one of the principal functions of the coxofemoral articulation, it is natural to think that pathological suppression of this function might be an important factor in the limp. This opinion, still widely held, constitutes a grave error, for two reasons:

1. Bony ankylosis of the hip, consequent to a true osseous fusion

\* To avoid burdening the reader with a long and tedious description, we have substituted a number of illustrations which will bear a careful study.

of the femur to the pelvis, causes only a very slight limp. To realize this it is necessary only to analyze the gait of patients with bony ankylosis. By the play of various and multiple compensatory movements, the mobility, though suppressed, is so well replaced that the gait may be surprisingly good. While it is not carried out in accordance with the mechanism of a well person, the disturbance is slight from the aesthetic, as well as from the functional, point of view. When these patients learn to utilize the compensations (and this is especially remarkable in the feminine sex), they arrive at the point of not limping at all, so to speak.

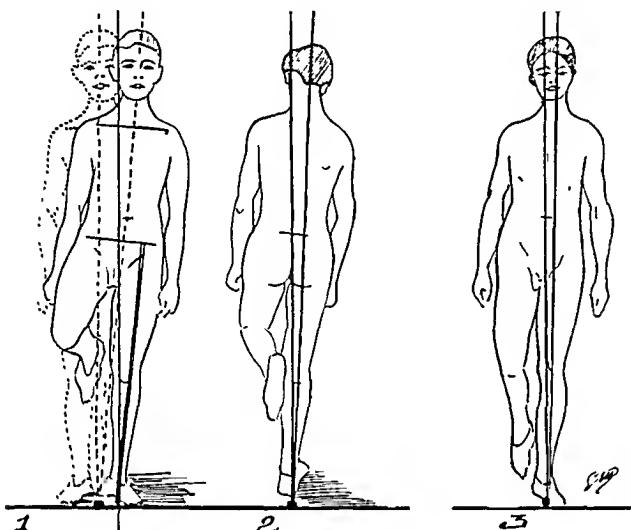


FIG. 1

#### Normal unilateral weight-bearing.

1: Superimposition of an outline drawing of a person standing with the weight on both feet upon that of the same person with the weight on the left foot alone. Note the total inclination of the body until the center of gravity of the person (umbilical region) is in the vertical line passing through the contact area of the weight-bearing foot. This lateral inclination necessitates a displacement of the head equal to three-fourths of its width. At the level of the shoulders the lateral displacement is approximately one-half the width of the head. The axis of the trunk and the axis of the lower weight-bearing member are both perpendicular to the bi-iliac line; consequently they are parallel to each other.

2: Posterior view of the same person.

3: Anterior view of a man in active motion. Note the lateral inclination of the entire body with parallelism of the axes of the trunk and of the weight-bearing member as in simple static weight-bearing, but the lateral displacement, being much less marked, does not, at the level of the head, amount to a third of its size.

—ascent of the pelvis, torsion of the body, accentuated lordosis—render walking possible, it is at the price of an awkward and painful limp, a limp entirely different from the antalgic limp. But, when the position of deformity has been corrected, which is usually easy and is frequently done, the antalgic gait, which has been disguised by the other, reappears with all of its characteristics.

Furthermore, they are able without fatigue to lead an extremely active life. Nothing, at least in their gait, recalls the habitual limp of coxalgia, which we have described in this article.

2. The less complete is the ankylosis, the more accentuated is the limp.

#### Deformity

What may be said in regard to the position of deformity as a cause of the coxalgic gait?

It is evident that a position of deformity—be it in flexion, in abduction, in adduction, or in rotation—when very marked provokes considerable difficulties in the gait, often to the point of rendering walking almost impossible. In which case, when compensatory attitudes

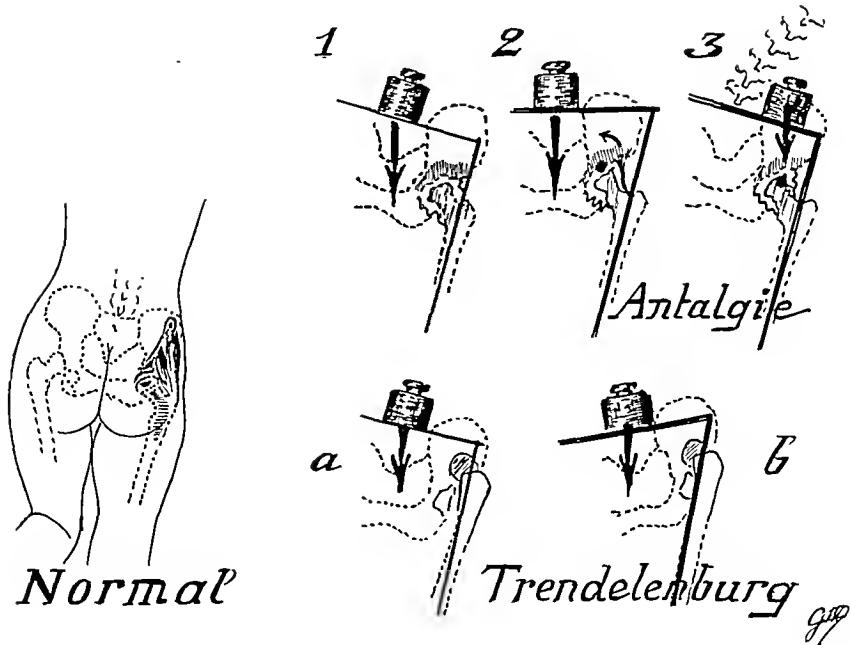


FIG. 2

Comparison of the normal, the antalgic, and the Trendelenburg gaits.

*At left:* In right-sided unilateral weight-bearing in a normal person, the transverse axis of the pelvis (bi-iliac line) remains perpendicular to the axis of the lower weight-bearing member, due to the contraction of the gluteus medius.

*1, 2, and 3:* Antalgic gait. When the atrophied gluteus medius cannot contract and when there is a damaged joint with the neo-capsule likely to become painful through strain, the weight of the trunk tends to induce closing of the angle between the pelvis and the axis of the weight-bearing member (*1* and *2*). In *2*, the outer part of the neo-capsule is painfully stretched. However, if, by lateral inclination of the trunk, the weight of the upper segments (trunk and upper member) is carried outside to a position directly above or even lateral to the level of the femoral head, the weight will be transmitted directly to the femur in such a way that there is no closing of the angle between the pelvis (bi-iliac line) and the axis of the weight-bearing member.

*a and b:* In congenital dislocation of the hip, the phenomenon of Trendelenburg is shown. The gluteus medius, the insertions of which are approximated, is inactive, and the weight of the trunk closes the angle between the pelvis and the weight-bearing member. There is no longer need of pronounced lateral inclination of the trunk because the closing of the angle does not produce a painful strain. The antalgic movement is not necessary. The capsule, which has retained its normal elasticity, gives without pain and without stretching. The iliac spine of the non-weight-bearing side descends, which is characteristic of the Trendelenburg gait.

### Trendelenburg Symptom

Is this limp, then, only a variant of the Trendelenburg symptom?

Here we must proceed more slowly for we are at the center of the question. It should be borne in mind that the Trendelenburg symptom is characteristic of the gait of those with congenital dislocation of the hip. (See Figures 2 and 7.) When a patient with congenital dislocation of the hip rests only on the leg of the affected side, the gluteus medius, through atrophy or through the approximation of its bony insertions, does not

sufficiently fulfill its physiological rôle. With its insertion on the trochanter, instead of fixing the pelvis and maintaining it in a horizontal position, this muscle permits the pelvis to see-saw under the combined weight of the body and of the opposite leg, whence the descent of the iliac spine of the sound side. This movement of descent of the pelvis is accompanied by a compensatory curve of the spine destined to draw toward the affected side the shoulder of that side, an attitude which is necessary to the statics of the body and which is accompanied by a lowering of the same shoulder. (See Figure 7.) When the patient walks, each time that the affected member bears weight, the dipping of the pelvis of the sound side and the inclination of the shoulder of the affected side give a characteristic manner to the gait, but if this gait is a distinguishing trait of congenital luxation, it has no association with that of coxalgia, as will be demonstrated.

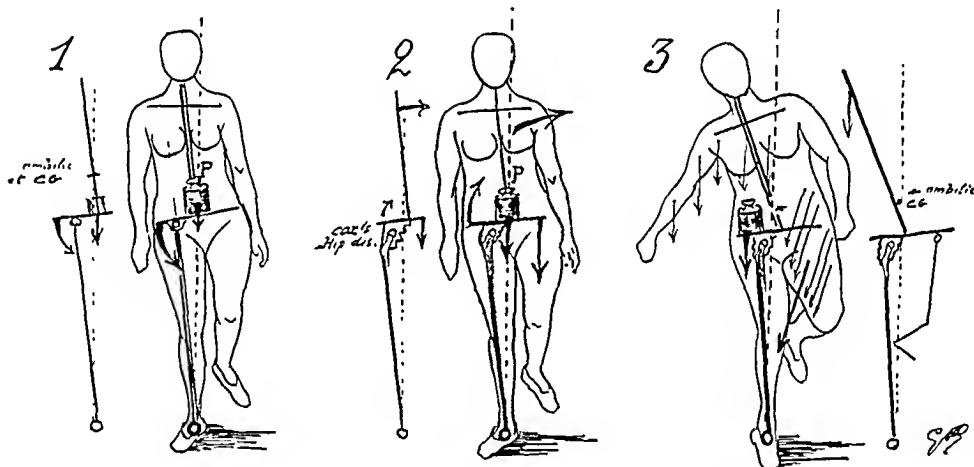


FIG. 3

## The antalgic gait.

**1:** Unilateral right-sided weight-bearing in a normal person, showing: total inclination of the trunk to the right; the center of gravity in the vertical line passing through the area of weight-bearing, contraction of the gluteus medius; the biiliac line and the weight-bearing axis forming a right angle or sometimes even an obtuse angle with parallelism of the axes of the trunk and of the inferior weight-bearing member.

**2:** The same positions in a person with coxalgia. The atrophied gluteus medius cannot maintain the pelvis horizontally; there follows a painful stretching of the external part of the capsule, a tendency to closure of the angle between the pelvic axis and the axis of the weight-bearing member, and a tendency to descent of the pelvis on the opposite side.

**3:** The antalgic movement, showing the inclination of the trunk toward the weight-bearing member and the arm on this side carried markedly outward in order to aid in the lateral displacement of the weight of the upper segments. The center of gravity of the trunk alone is carried over the femoral head. There is no longer stretching of the capsule, but the non-parallelism of the axis of the trunk and the axis of the lower weight-bearing member may be observed. In addition, the ankle of the opposite side, which rests upon the knee of the weight-bearing side, permits the transposition of the weight of the non-weight-bearing member to a point outside of the affected hip.

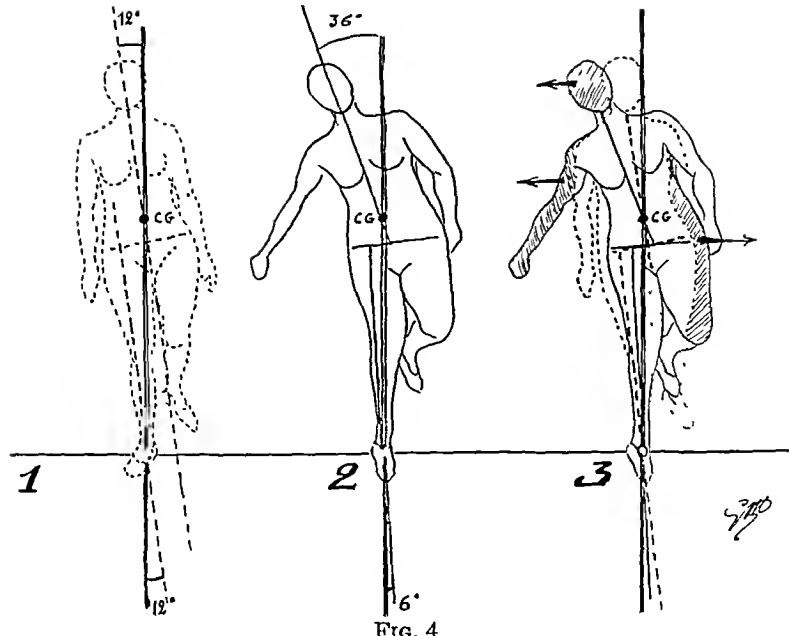


FIG. 4

Comparison of the antalgic gait and the normal unilateral weight-bearing position.

1: The normal unilateral weight-bearing position.

2: The antalgic unilateral weight-bearing position.

3: Superimposition of the normal unilateral weight-bearing position on the antalgic unilateral weight-bearing position.

The superimposition of these two drawings shows the strong inclination of the trunk in 2, which is shown lying outside of the normal weight-bearing position (1) on the side of the weight-bearing member. Inversely, and as a result, the slight inclination of the weight-bearing member forces the pelvis in the antalgic gait to lie outside of the position of the pelvis in the normal gait on the non-weight-bearing side. The impression is given that, if there is a displacement of the upper part of the body toward the weight-bearing side, the displacement of the pelvis will be toward the opposite side. In Fig. 6, the displacement of the center of gravity of the body explains the slight inclination of the weight-bearing member.

FIG. 5

The movements of a coxalgic person—from the position of weight-bearing on two feet to a position of weight-bearing on the affected leg.

1: The median center of gravity (umbilical region) is vertical, passing between the soles of the feet, but even before the weight is brought onto the affected hip, before the sound leg has left the ground, the trunk is inclined toward the side that is affected by coxalgia.

2: The center of gravity is no longer in the middle, but is displaced toward the side affected by coxalgia so as to be almost above the femoral head.

3: The sound leg has left the ground and the inclination of the trunk toward the weight-bearing member affected by coxalgia remains the same. There is only need of a slight lateral inclination of the weight-bearing member to bring the center of gravity, previously lateral, above the contact area of the weight-bearing foot.

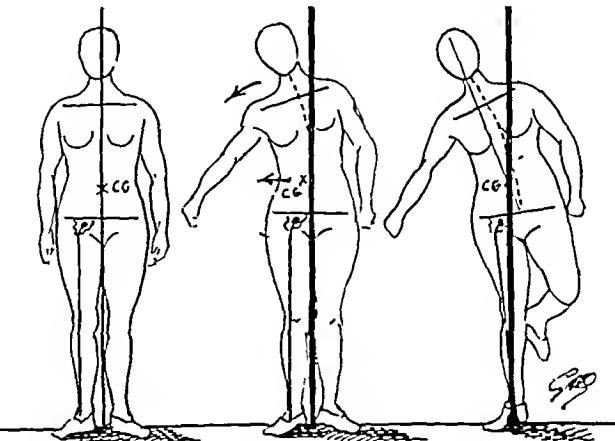


FIG. 5

FIG. 6

Schematic drawings demonstrating the progressive phases of the antalgic gait. The small figures 20, 1, 2 and 3 show bilateral weight-bearing, with the member affected by coxalgia in front.

Figures 4 to 10 demonstrate unilateral weight-bearing on the member affected by coxalgia; figures 11 to 18, bilateral weight-bearing, with the member affected by coxalgia behind.

It is clear that the antalgic inclination takes place during the time of bilateral weight-bearing, which precedes weight-bearing on the affected side, and later follows it. The antalgic gait is at the same time ante-algic and post-algic.

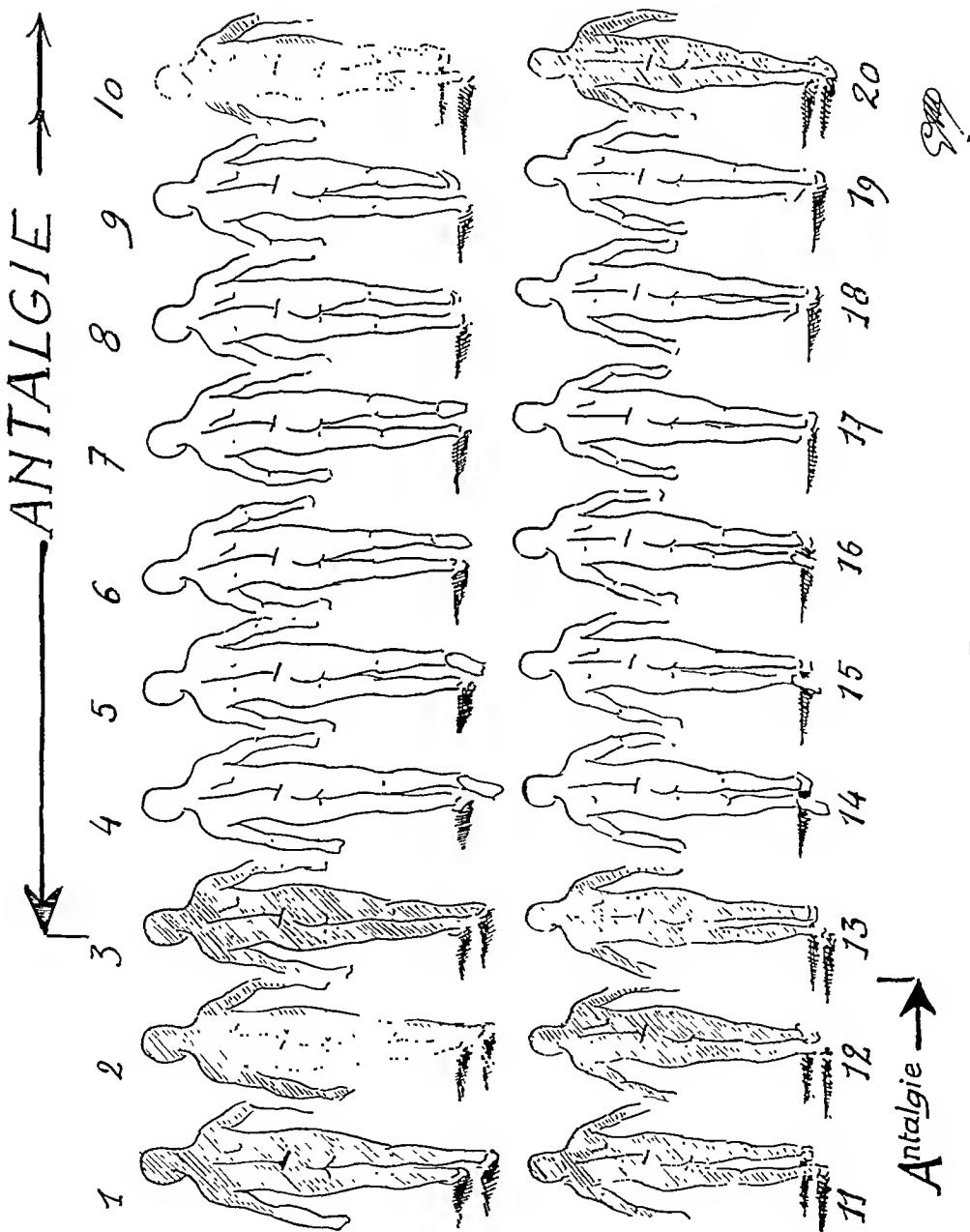


FIG. 6

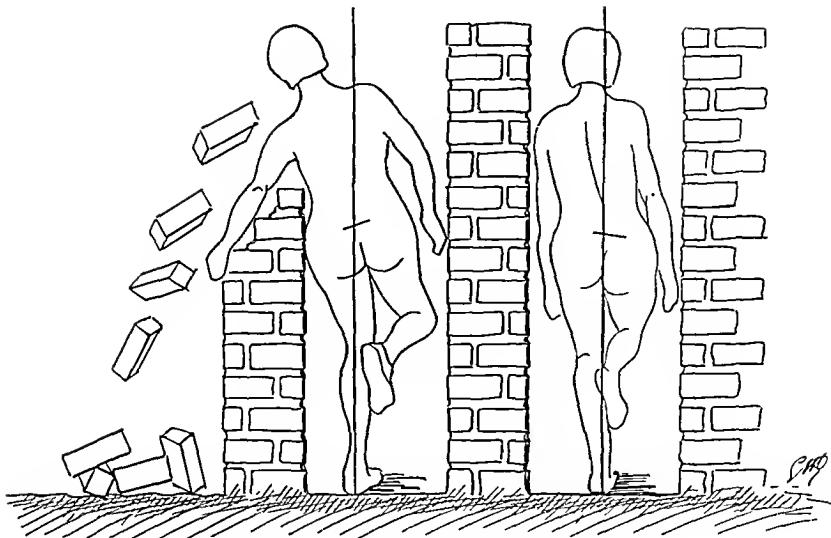


FIG. 7

Comparison between the antalgic gait and the pure Trendelenburg gait. The figure on the left represents an individual with coxalgia; that on the right, a person with congenital dislocation of the hip. The silhouette of the antalgic person goes beyond the frame and "breaks the wall". The silhouette of the individual with the Trendelenburg gait remains well encased. (See Fig. 8.)

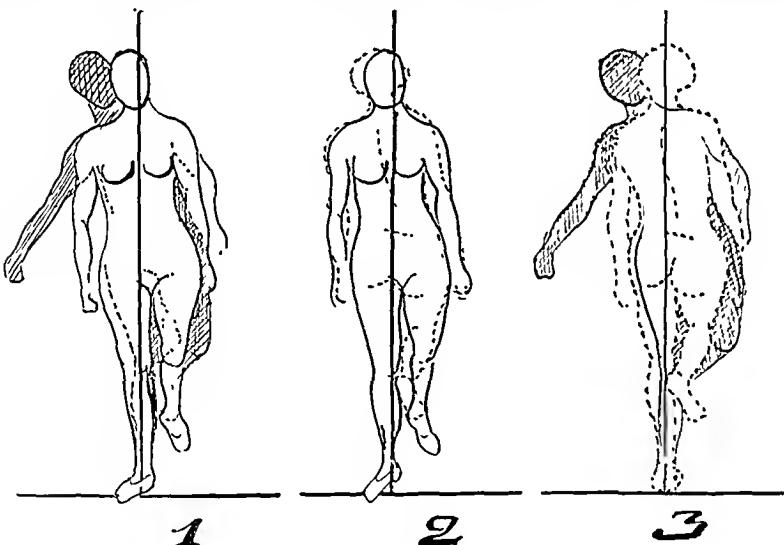


FIG. 8

1: Superimposition of the image of an antalgic patient upon that of a person in the normal unilateral weight-bearing position. The upper part of the antalgic trunk shows a marked lateral projection. (See Fig. 5.)

2: Superimposition of the image of a patient with the Trendelenburg gait upon that of a person in the normal weight-bearing position. The silhouettes are superimposed almost exactly. In the case of the Trendelenburg gait, the variation is at the interior of the silhouette and is essentially a descent of the pelvis on the non-weight-bearing side, with a curved spine as compensation.

3: Superimposition of the image of an antalgic patient upon that of a patient with the Trendelenburg gait. The image of the former projects from that of the latter as in 1,—it projects from the normal unilateral weight-bearing position.

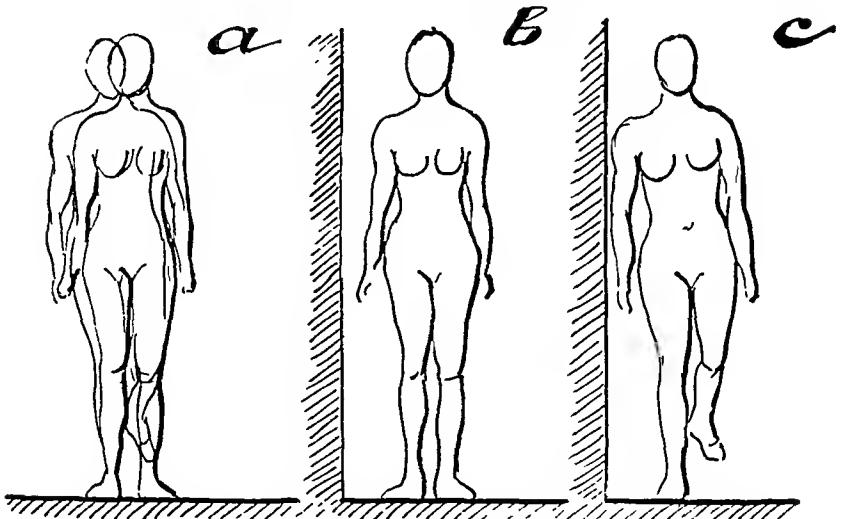


FIG. 9-A

## The wall test.

*a, b, and c:* Normal individual. In normal unilateral weight-bearing the lateral displacement of the head is about one-half or three-fourths of its width. The displacement at the shoulders is about one-half the width of the head. If one wishes a normal person standing near a wall to assume a position of unilateral weight-bearing on the member next the wall, in order to make it possible for him to raise the opposite leg, it is necessary to place him away from the wall at least one-half the width of his head. If this is not done, the opposite leg cannot be lifted from the ground unless the trunk is displaced three-fourths of the width of the head in order to allow displacement of the shoulders.

#### DIFFERENTIATING CHARACTERISTICS OF THE SO-CALLED TRENDLEENBURG LIMP AND OF THE ANTALGIC LIMP

First, let us study the attitude of the coxalgic patient when he rests on one foot, the affected member being the weight-bearing one. It consists essentially in a displacement of the shoulder of the affected side. (See Figures 3, 4, 5, and 7.) It is not a lowering of the shoulder as in the Trendelenburg gait. It is a true lateral displacement of the shoulder and of a part of the trunk. It makes a break in the body immediately above the pelvis at the level of the lumbar spine.

If one imagines the patient to be in a frame (Fig. 7), in this position of weight-bearing, one part of the body is propelled from the frame, and "breaks the wall" on the affected side. Moreover, and this is perhaps the most characteristic sign of the antalgic gait, this displacement of the body toward the affected side occurs before the affected member becomes the weight-bearing member. This movement of lateral projection occurs when the two feet are still on the ground, in the phase of bilateral weight-bearing before the unaffected member has been raised from the ground. Furthermore, the foot on the unaffected side can be raised from the floor only after this displacement of the body has occurred. This is so true that, if one prevents in any fashion this preliminary displacement of the body (Fig. 9-B), the raising of the foot on the unaffected side is actually

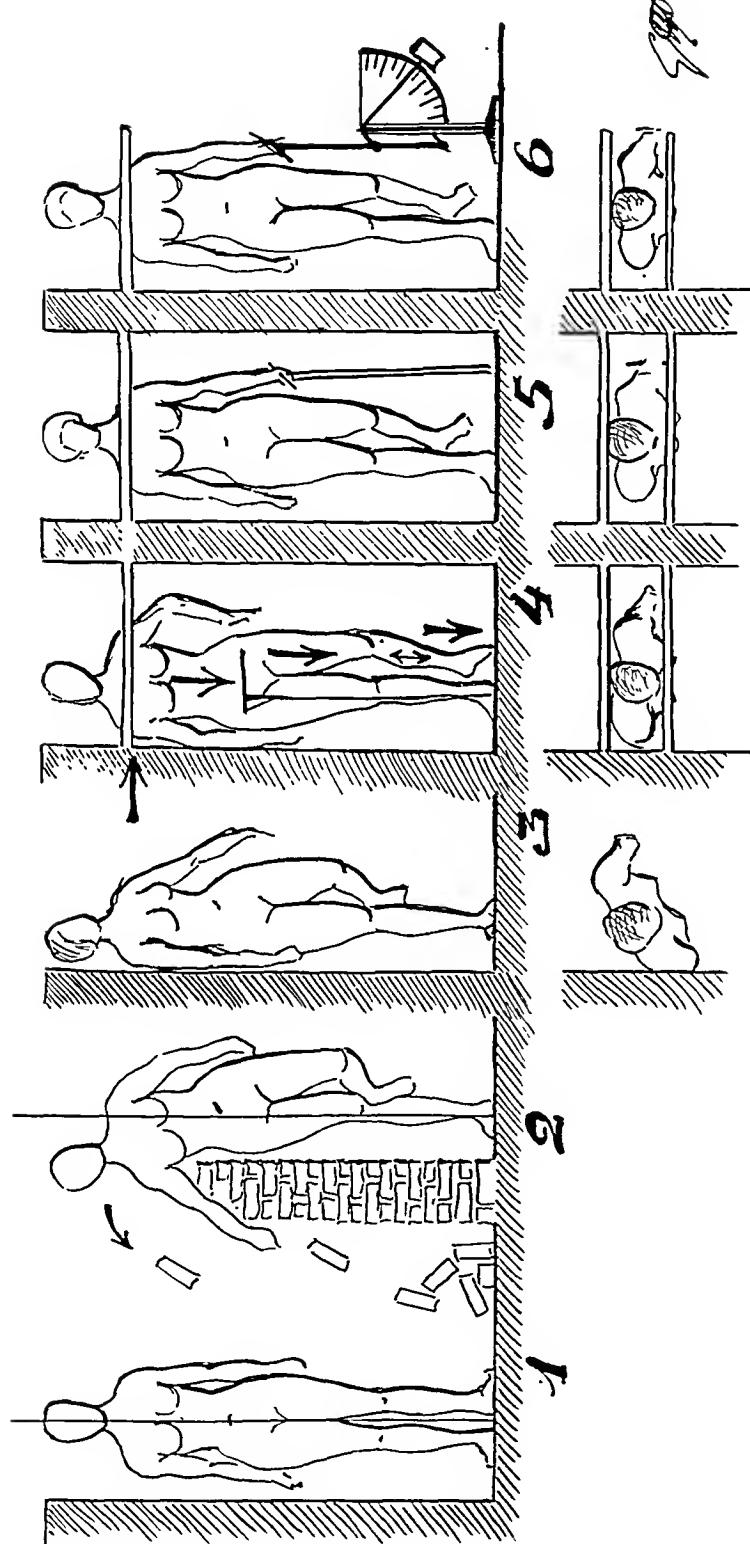


FIG. 9-B

*1 to 6:* Individual with coxalgia. The patient stands near the wall (1). He is placed away from the wall a distance of one-half the width of his head (sufficient for a normal person). Due to the projection of the antalgic position outside of the frame, the patient breaks the wall (2). However, ordinarily the wall resists, and by means of a trick—twisting the trunk and carrying the right shoulder either forward or backward—the patient assumes unilateral weight-bearing (3). In order to prevent the patient from using this trick, we place two jars which hinder twisting of the trunk (4, 5, and 6). The patient cannot raise the sound leg (4). The wall resists and repulses the patient. The body weight falls on the pelvis, stretches the capsule, and causes pain. All efforts to raise the sound leg are blocked. If, however, the weight acting on the left half of the body is borne on a cane, the equivalent of a bipedal support is reestablished (right leg and cane) and the sound leg, situated between the two weight-bearing points, can be lifted (6). The question then arises: Why not measure the pressure borne by the cane? From this was developed the idea of a dynamometric cane in the manner of a letter scale (6).

impossible (Fig. 6). It is altogether different in the Trendelenburg gait. In this, as in the normal gait, the patient lifts, without effort, the foot on the unaffected side and it is only after the affected member becomes weight-bearing that the pelvis descends on one side and the shoulder on the other. Finally, in the antalgic gait, the iliac spine remains at the same level during the entire period of the step.

In résumé, the Trendelenburg gait and the antalgic gait are two absolutely different phenomena (Figs. 7 and 8). In the antalgic gait, the displacement of the shoulder precedes the raising of the foot on the unaffected side; in the Trendelenburg gait, the lowering of the shoulder follows it. In the antalgic gait, the shoulder of the affected side and a part of the trunk are projected laterally (out of the frame). In the Trendelenburg gait, the shoulder descends, but it is not projected and in any case does not go out of the frame. Finally, in the antalgic gait, the iliac spine does not move. In the successive stages of the step, the angle made by the femur with the bi-iliac diameter at the iliac spine does not vary. On the

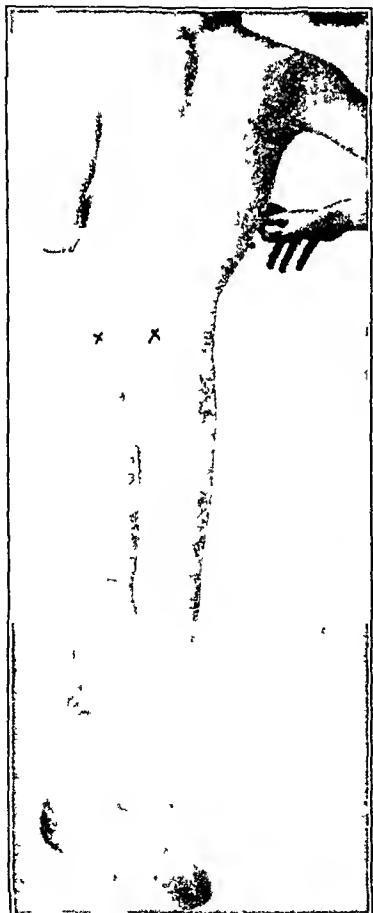


FIG. 10-A



FIG. 10-B

Photographs of two patients with the antalgic gait, showing unilateral weight-bearing on the member affected by coxalgia.

other hand, in the Trendelenburg gait, the iliac spine (and this is the characteristic symptom) descends on the unaffected side when the affected side is weight-bearing.

#### PATHOGENESIS

These clinical differences between the antalgic and the Trendelenburg gaits correspond to a profound difference in the nature of the causes that produce these limps.

In the Trendelenburg gait, it is the question of a purely mechanical phenomenon. The insufficiency of the gluteus medius causes a pivoting of the pelvis around the femoral head; the descent of the iliac spine on the opposite side is only the result of this movement. Nothing in the coxo-femoral articulation opposes this movement of pivoting. (See Figure 2.)

It is altogether different in coxalgia. (See Figures 2 and 3.) Here we find ourselves in the presence of a reflex mechanism, an attitude of defense in every way comparable to the winking of the eye before the threat of a blow. The lowering of the lid has already been accomplished when the blow lands, and the eye is protected. The special attitude of the body in cases of coxalgia—the projection which precedes raising the foot on the unaffected side—and the brief period of weight-bearing on the affected side are instinctive movements to protect the coxfemoral articulation from trauma and from the strain which occurs at its level if the action of the body weight is allowed to exert itself as in a normal hip.

The coxalgia has destroyed the articular surfaces and the capsule. In place of the original articular surfaces, there is established a pseudarthrosis more or less firm between what remains of the head, of the neck, and of the acetabulum. The capsule has been replaced by bundles of scar tissue forming a true neo-capsule. The gluteus medius has lost all its functional value. If not destroyed, it is completely atrophied. Moreover, due to the osteo-articular destruction, the normal relation of its bony insertions is markedly modified; physiologically it is no longer of account.

Thus, in the unilateral weight-bearing of the coxalgic hip, the neo-capsule of scar tissue is the only element present to oppose the descent of the pelvis, which is produced in the Trendelenburg gait. This neo-capsule, however, is not capable of supporting such an effort; the fibrous tissue which constitutes it is insufficiently resistant and without elasticity. If stretched, it would easily become painful. It is in a state of constant irritation at the least movement tending to strain the pseudarthrosis. In order to avoid the strain which would inevitably be caused, the patient assumes an attitude of defense, the antalgic attitude. This attitude aims to displace the center of gravity of the upper segments of the body (trunk, head, and upper extremities) and to carry it over the line of the femoral head or beyond that line. (See Figures 2, 3, and 5.) The principle is the same as that of a steelyard in which the long lever is unloaded in favor of the short one. Thanks to this displacement of the center of gravity, there is no longer a tendency to adduction of the pelvis in relation to the femur

or to closure of the angle between the femoral axis and the transverse diameter of the pelvis. The articular scar tissue is no longer stretched; this explains why the displacement of the body occurs while there is bilateral weight-bearing and does not cease until the bilateral weight-bearing is reestablished.

This explanation applies equally well to the variations of the antalgic gait:

1. Theoretically it is impossible to have an antalgic gait when the hip is firm and capable of transmitting the body weight to the lower extremity. Observation verifies this fact. There is no antalgic gait when coxalgic conditions terminate in a true bony ankylosis, either spontaneous or operative (arthrodesis).

2. The antalgic gait is slight in certain very rare cases where, contrary to the rule, the gluteus medius has conserved an important functional value and especially in the cases where the neo-capsule is formed of tissue so tight that the ankylosis seems complete and comparable to a bony ankylosis.

The antalgic gait may vary in a given patient. For instance, it is conceivable that the sensitiveness of the neo-capsule of scar tissue may be influenced favorably or unfavorably by certain factors. The antalgic gait (attitude of defense) may be improved or it may become worse. For example, fatigue markedly aggravates the antalgic gait. This antalgic gait may appear after a long walk in patients who usually do not show it.

Also, like rheumatic manifestations, the antalgic gait undergoes variations in relation to meteorological conditions.

#### THERAPEUTIC DEDUCTIONS

The pain can be greatly relieved if the patient uses a cane on the unaffected side. At the moment when the foot on the unaffected side must be raised from the floor, the patient leans heavily on the cane, which, by lessening so much the weight on the affected leg during its period of weight-bearing, reduces to a minimum the oscillation of the trunk and the shoulder.

One of us (Calvé) has had the idea of measuring the degree of intensity of the antalgic gait, and Galland has constructed a true hip scale like a letter scale. It is a sort of dynamometric cane, the function of which is shown in Figure 9-B. This apparatus serves equally to measure the result obtained by an arthrodesis of the hip and to express it in kilograms.

An understanding of the dominant cause of the coxalgic limp will allow the specialist to avoid some disappointments and will indicate to him the method of treatment to follow. We repeat, we do not minimize the part that shortening or a position of deformity may play in the difficulties of the gait of those with coxalgia. We are entirely of the opinion that it is necessary to correct them as completely as possible for aesthetic reasons and for the comfort of the patient, but they are only accessory

factors, and one should not promise the patient that after their correction the limp will cease.

The only treatment to carry out is to ankylose the hip in the most solid fashion obtainable. The logical operation is arthrodesis.

#### CONCLUSIONS

In conclusion, we believe that we have proved that the limp of coxalgia is a limp of escape, a limp of defense by antalgic reflex.

The antalgic gait, it should be noted, is not associated exclusively with coxalgia. It is seen in all conditions causing instability of the hip. It is very frequent in congenital dislocations of the hip, particularly in those cases of subluxation in which the phenomena of arthritis predominate over those due to interference with the static equilibrium. We have frequently seen patients with bilateral congenital dislocation of the hip present the Trendelenburg sign on one side and the antalgic limp on the other, or show the antalgic limp only periodically.

The antalgic limp is an indication of the degree of irritability of the fibrous neo-capsule in coxalgia, or of the deformed capsule of congenital dislocation of the hip. It is for the same reason that the antalgic gait characterizes the limp of those with arthritis deformans of the hip. Here again, the antalgic movement makes possible the avoidance of pain.

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## EWING'S SARCOMA

BY CHARLES F. GESCHICKTER, M.D., AND I. H. MASERITZ, M.D.,  
BALTIMORE, MARYLAND

*From The Surgical Pathological Laboratory and Department of Orthopaedic Surgery,  
Divisions of Surgery, The Johns Hopkins Hospital and University, Baltimore*

The present article deals with the diagnostic features of Ewing's sarcoma and is based on the study of 135 cases.

The age, sex, duration of symptoms, and systemic manifestations of the disease, while valuable adjuncts in diagnosis, were not found to be conclusive findings. The tendency of Ewing's sarcoma to diminish rapidly in size under irradiation provides an important diagnostic feature. This reaction is by no means specific, since metastatic lesions and osteolytic osteogenic sarcoma were also found to respond to deep roentgen therapy, although not so rapidly. On the other hand, the appearance of the lesion in the roentgenogram offered a comparatively positive means of diagnosis in more than 70 per cent. of the cases. Since the element of error could not be eliminated entirely, the diagnosis necessarily rests, in the last analysis, on the microscopic findings.

A comparative study of Ewing's sarcoma and sclerosing osteogenic sarcoma failed to reveal any serious difficulties in differential diagnosis. The roentgenographic changes in sclerosing sarcoma are sufficiently constant to be considered pathognomonic. There is a tendency to patchy sclerosis in the involved bone and irregular ossification in the periosteal zone (Fig. 1). The roentgenographic changes in early growths do not present these features so distinctly, but are sufficiently characteristic to distinguish them from the changes in Ewing's sarcoma.

Osteolytic osteogenic sarcoma can usually be differentiated from Ewing's sarcoma by roentgenographic examination. Occasionally, however, this lesion exists as a circumscribed area of bone destruction with periosteal reaction (Fig. 2) and then can only be diagnosed by biopsy. The roentgenographic changes in chondrosarcoma were commonly found to resemble sclerosing osteogenic sarcoma, but in several instances simulated Ewing's sarcoma or osteomyelitis (Fig. 3). This may be a difficult diagnostic problem, which can be settled only by microscopic study.

A study of the various metastatic lesions, multiple myeloma, Christian's disease, and leukaemic involvement of bone, including lymphosarcoma, failed to reveal any serious possibility of error. Lymphosarcoma, metastasizing to bone, might simulate the changes in Ewing's sarcoma, but the clinical data and tendency to multiple bone involvement should be sufficient to avoid the possibility of error. Neuroblastoma was found to resemble Ewing's sarcoma clinically and microscopically. This tumor tends to be multiple and more commonly occurs in the first five

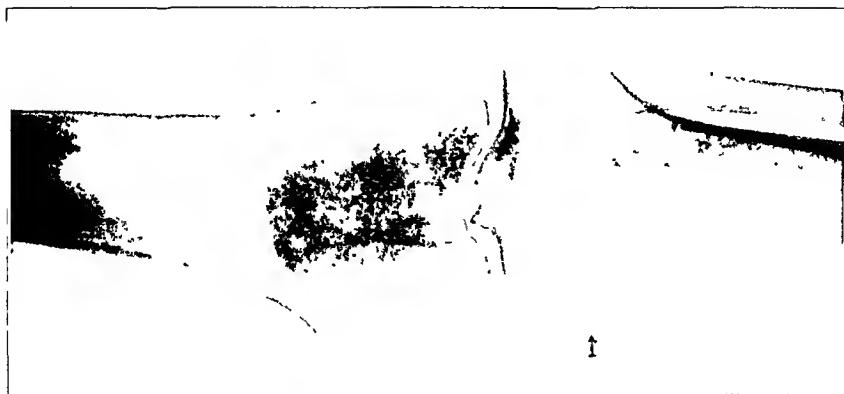


FIG. 3

P.N. 58256. Chondromyxosarcoma of the tibia. Anteroposterior view.



FIG. 2

P.N. 57864. Osteolytic osteogenic sarcoma of the tibia.



FIG. 1

P.N. 55728. Sclerosing osteogenic sarcoma of the tibia. Anteroposterior view.

years of life, whereas occurrence in the second decade is more common in Ewing's sarcoma\*. Both tumors respond to irradiation. The presence of rosettes and neurocytes are distinctive histological features of neuroblastoma, and furnish a basis for diagnosis. In a series of forty-two cases, listed under miscellaneous affections, which also included Paget's disease, osteoporosis, and osteopetrosis, there was no instance in which the bone changes suggested Ewing's sarcoma.

The resemblance between Ewing's sarcoma and subacute and chronic osteomyelitis offers a very serious problem. The similarity may be quite marked and may extend to the clinical factors of age, sex, race, mode of onset, duration of symptoms, and roentgenographic and physical findings. Fifty per cent. of the cases of Ewing's sarcoma, as compared to 46 per cent. of the cases of osteomyelitis, were found to occur between ten and twenty years of age.



FIG. 4-A

P.N. 49266. Osteomyelitis of the femur.

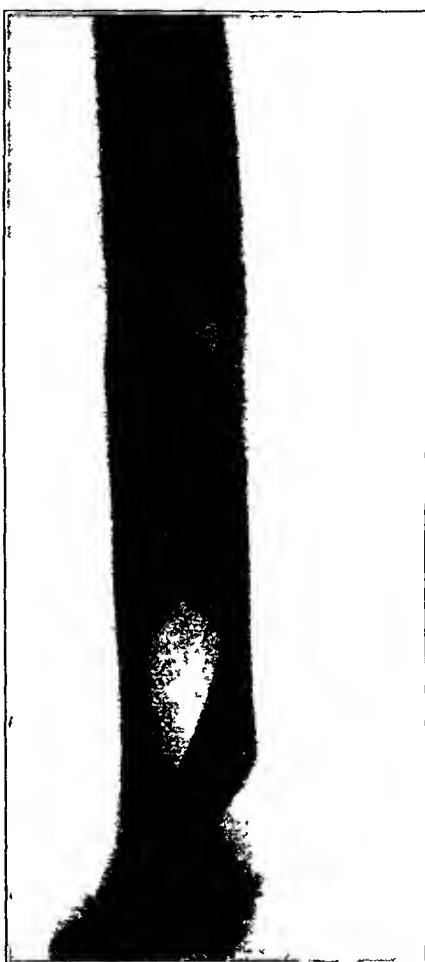


FIG. 4-B

P.N. 58826. Ewing's sarcoma of the femur.

\* The problem of distinguishing between these two diseases is extremely difficult in a group of prevertebral small round-cell sarcomata which involve the vertebrae or sacrum in adults (Rix and Geschickter).



FIG. 5-A  
P.N. 49302. Osteomyelitis of  
the fibula.



FIG. 5-B  
P.N. 58682. Ewing's sarcoma of the  
fibula.



FIG. 6-A  
P.N. 59044. Osteomyelitis of  
the tibia.

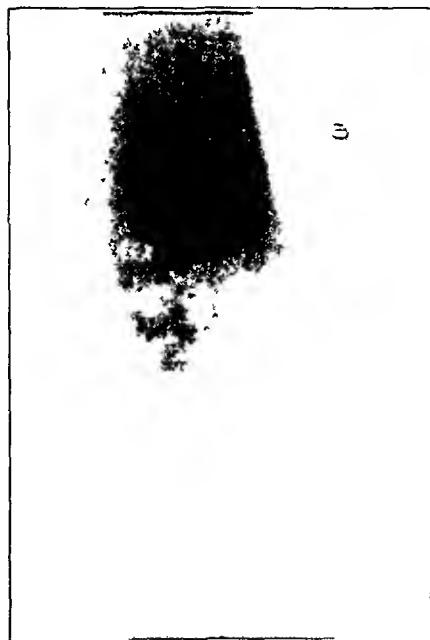


FIG. 6-B  
P.N. 51566. Ewing's sarcoma of the  
femur.

In both conditions, males were affected more frequently than females in a ratio of two to one. In the collection of cases of Ewing's sarcoma, there was one colored patient, while in 125 cases of osteomyelitis, there were eight. Trauma played an equal rôle in both diseases. The average duration of symptoms in cases of Ewing's sarcoma was ten months. The shortest duration was a few days and the longest, one year. In subacute osteomyelitis, the average duration was 19.3 days, and in chronic osteomyelitis 4.7 months. Tumefactions occurred in both. Elevation of temperature and leukocytosis were common in both conditions. In Ewing's sarcoma, the temperature varied from 99 to 104 degrees, with an average of 100 degrees. The average temperature in osteomyelitis was 101.5 degrees. Forty patients with Ewing's sarcoma showed leukocyte counts of less than 20,000 and more than 10,000. The average count in osteomyelitis was 12,056.



FIG. 7-A



FIG. 7-B

P.N. 58685. Photomicrograph cut transversely across the shaft. The soft tissues on either side are the remains of muscle, tendons, and periosteum. The medullary cavity has been completely obliterated. Note the beginning formation of transverse spicules at the right side of the periosteum.

FIG. 7-A

P.N. 58682. Roentgenogram of the gross specimen shown in Fig. 5-B. Note the broadening of the shaft and the obliteration of the medullary cavity. (See Fig. 7-B.)

The combined effects of bone destruction, periostitis, and reactive bone formation in osteomyelitis often result in roentgenographic changes which closely resemble those in Ewing's sarcoma (Figs. 4-A through 6-B). This similarity is the result of common characteristics. Ewing's sarcoma is an invasive tumor, which tends to extend longitudinally along the shaft, invading the medullary cavity and destroying bone spicules in its course. In response to this invasion and destruction, new bone is laid down both subperiosteally and subendosteally. The tumor tissue possesses no properties of osteogenesis. The ratio of bone destruction and new bone formation is variable and inconsistent, giving rise to numerous roentgeno-

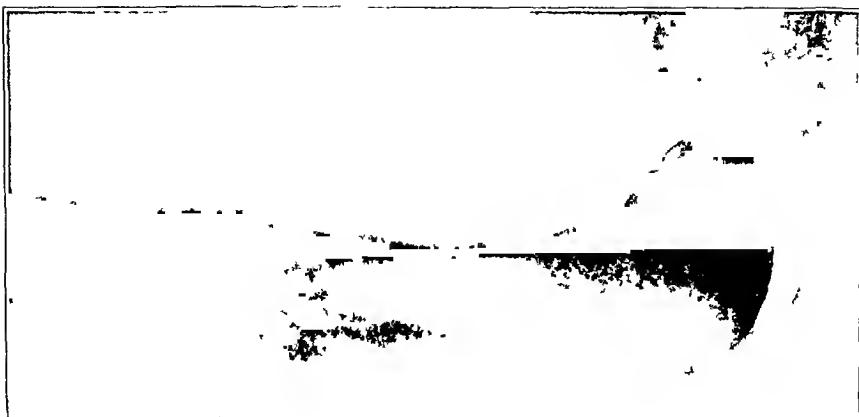


FIG. 9

P.N. 32174. Ewing's sarcoma of the femur, showing "groomed whiskers". (Roentgenogram of gross specimen.)



FIG. 8

P.N. 28835. Ewing's sarcoma of the femur, forming a large soft-tissue mass. (Roentgenogram of gross specimen.)



FIG. 10

P.N. 51566. Ewing's sarcoma of the femur, showing less marked changes of "groomed whiskers".



FIG. 11

P N. 55668. Photomicrograph (low magnification) showing collections of endothelial cells in early changes of Ewing's sarcoma.

graphic pictures (Figs. 4-B, 5-B, and 6-B). The so-called onion-peel formation in Ewing's sarcoma is the result of multiple parallel rows of reactive bone separated by tumor tissue. Often the extent of bone reaction is proportionally greater than the rapidity of tumor growth, resulting in a broad sclerotic shaft (Fig. 5-B). The cause of sclerosis is an encroachment of the reactive bone on the soft tissues surrounding the cortex and on the medullary cavity, which it tends to obliterate (Figs. 7-A and 7-B). The tumor tissue will often overcome this defensive mechanism and grow outward from the periosteal covering, forming a soft-tissue mass, which is surrounded by a thin wall of connective tissue (Fig. 8).

Connor, Kolodny, and others have observed transverse striations in the roentgenograms of occasional cases of Ewing's sarcoma. These



FIG. 12

P.N. 57722. Photomicrograph (low magnification) of reticulum-cell variety of Ewing's sarcoma.

transverse striae (Fig. 9) are similar to those previously mentioned under the discussion of sclerosing osteogenic sarcoma (Fig. 1). The similarity occasionally leads to difficulty in diagnosis. Two distinct differences were observed. The transverse striae of Ewing's sarcoma are fine, hair-like, and best described by the term "groomed whiskers", while those of sclerosing osteogenic sarcoma are coarse and do not present the "groomed whiskers" effect. The roentgenographic changes in sclerosing osteogenic sarcoma are those of a patchy sclerosis. Involvement is usually confined to a limited area of the distal portion of a shaft and gives one the impression of tumor formation. This is not ordinarily true of Ewing's sarcoma,

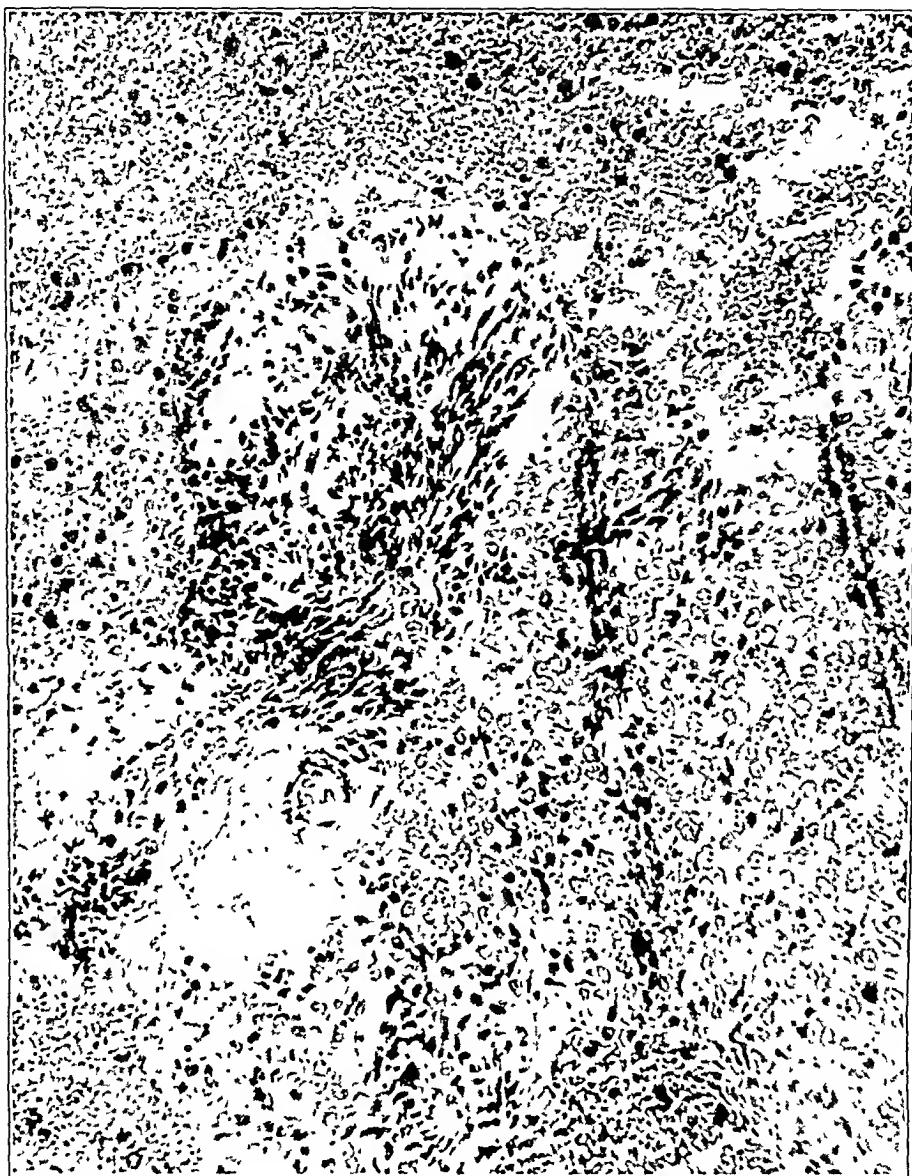


FIG. 13

P.N. 48886. Photomicrograph (medium magnification) showing spindle-like cells in Ewing's sarcoma.

which most often involves from one-third to one-half of the shaft and commonly possesses a resemblance to osteomyelitis. Transverse striae in Ewing's sarcoma were seldom present to the extent observed in Figure 9, but were found to exist in a large percentage of cases as fine hair-like processes projecting at right angles from the periosteum (Fig. 10). They are the result of reactive bone, similar to the osteoid-tumor tissue in sclerosing sarcoma. These changes can best be observed by using a proper soft-tissue x-ray technique in suspected cases, and were found to be a valuable adjunct in making a differential diagnosis. The changes are

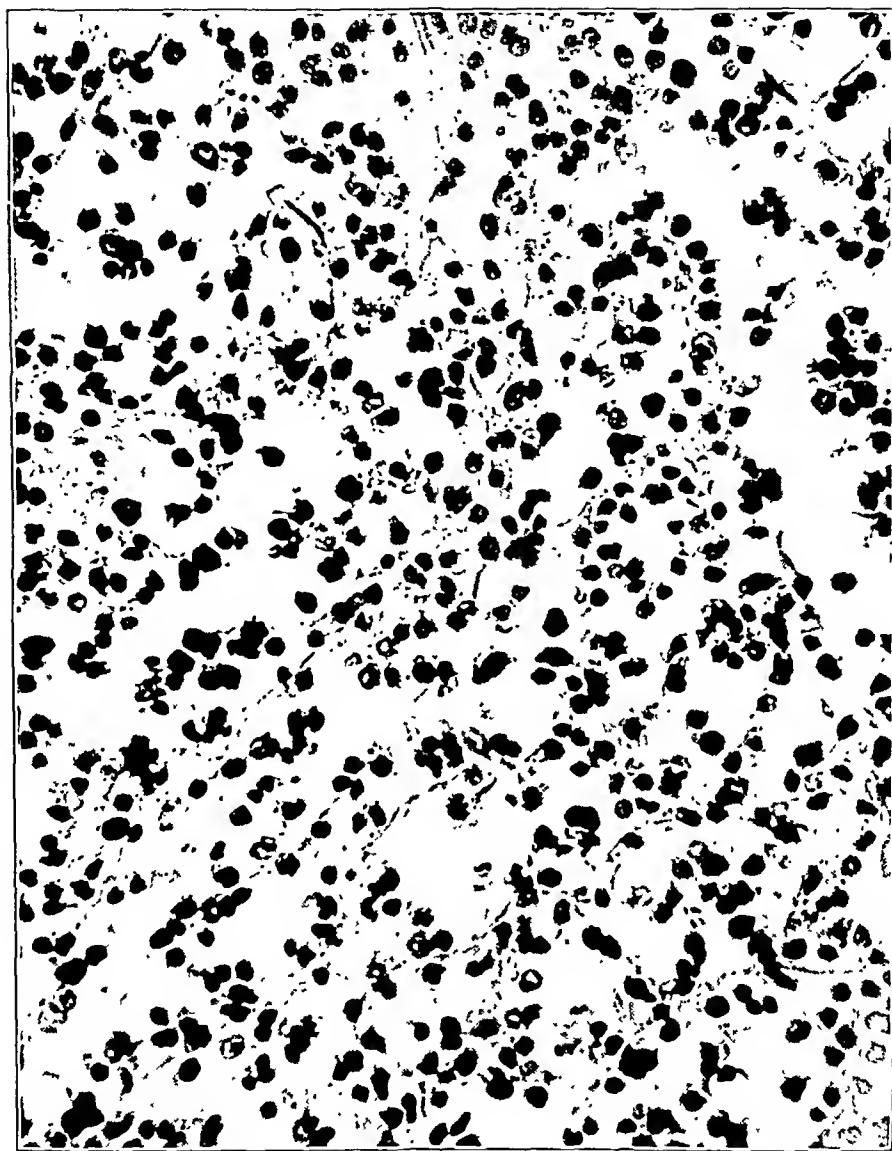


FIG. 14

P.N. 40440. Photomicrograph (high magnification) showing lymphoid-like cells in Ewing's sarcoma.

not pathognomonic of Ewing's sarcoma and are occasionally simulated by chondromyxosarcoma. They are, however, characteristic of malignancy.

The pathology of endothelioma involving bone was described as early as 1866 by Lücke. In the latter part of the nineteenth and in the first quarter of the present century, numerous descriptions of this tumor found their way into the literature. It is now generally conceded that many of these tumors were not endothelioma. Ewing, in 1922 and in later publications, was responsible for the acceptance of this tumor as a separate entity. Endothelial myeloma must be accepted as an individual form of

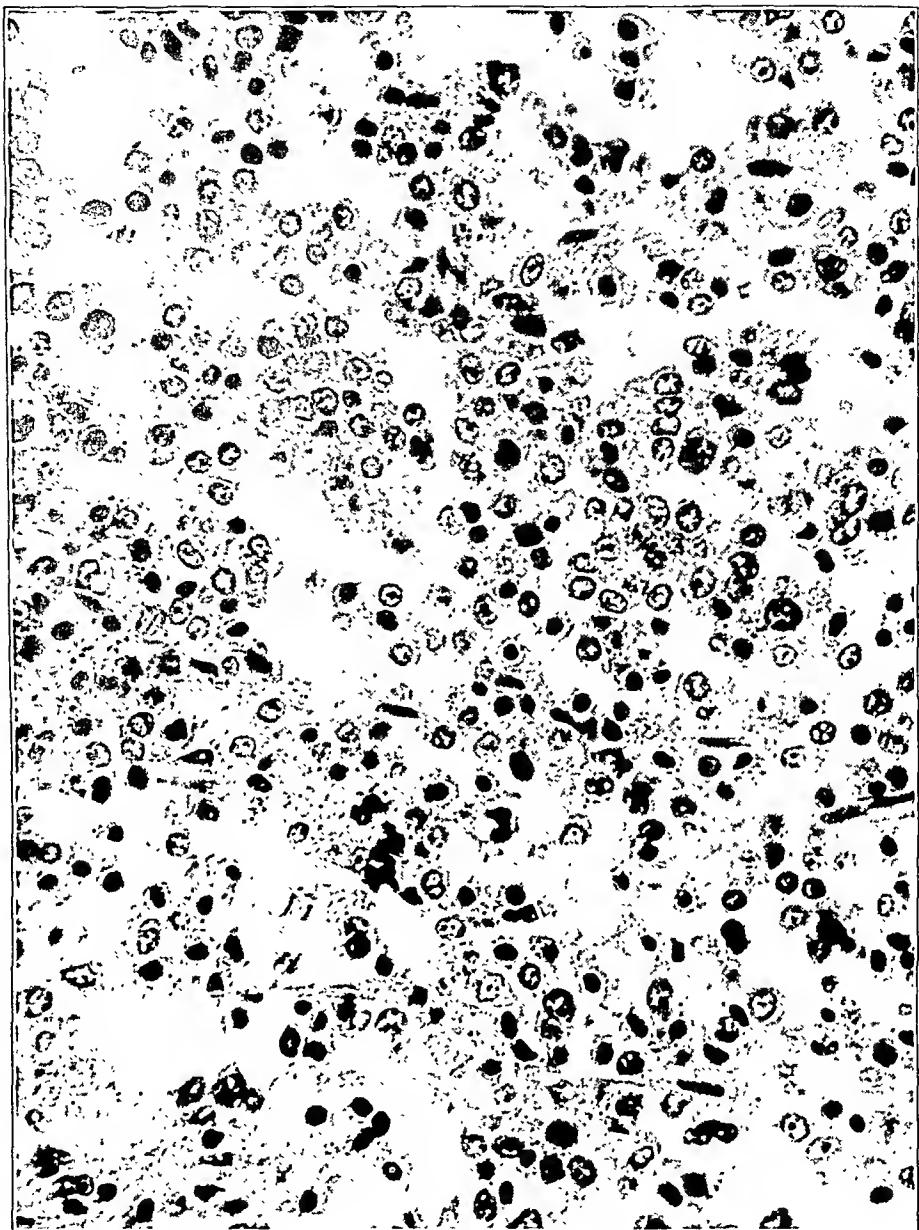


FIG. 15

P.N. 49746. Photomicrograph (high magnification) showing myeloid-like cells in Ewing's sarcoma.

bone sarcoma, but there is considerable doubt concerning the microscopic subdivisions. Ewing described three types,—multiple, diffuse, and angio-endothelioma. Kolodny considered angio-endothelioma a specific entity. Connor wrote of an angio-endothelioma, a diffuse endothelioma, and a reticular type of endothelioma. Waldeyer and others described a perithelioma.

There was no instance in the present series of cases of Ewing's sarcoma in which the diagnosis of angio-endothelioma was justified. Sec-



FIG. 16

P.N. 43608. Photomicrograph (low magnification) showing changes in a typical section of Ewing's sarcoma.

tions submitted to this laboratory for the confirmation of diagnosis of angio-endothelioma usually fell into a doubtful group. It is readily understood how metastatic hypernephroma, anaplastic and mucoid forms of carcinoma, and angiosarcoma can possibly be diagnosed as angio-endothelioma.

True endothelial myeloma offers a variable but specific microscopic picture. The earliest changes are probably those seen in marrow spaces where tumor invasion has just begun. In these instances, the surrounding

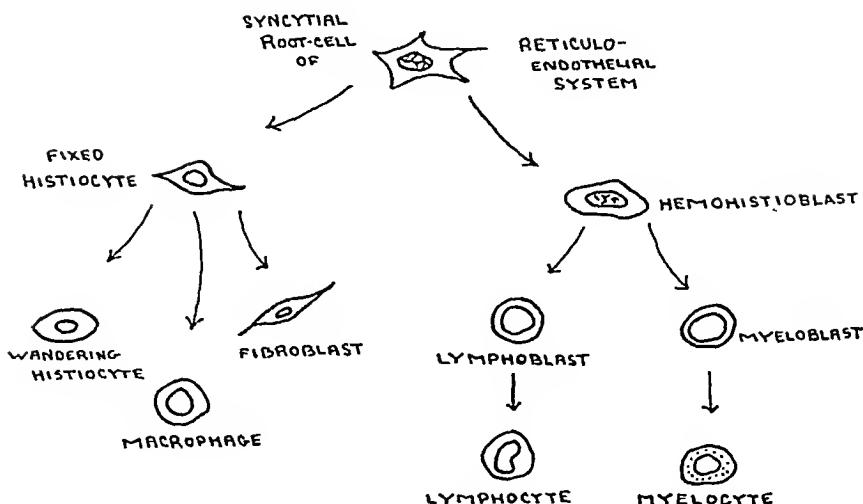


FIG. 17

Diagram of the genetic relationship of the principal elements of the reticulo-endothelial system. (By courtesy of T. R. Waugh and *The American Journal of Medical Sciences*.)

connective tissue is fibrosed, and in areas it is difficult to differentiate between lamellated fibroblasts and compressed tumor cells. Patches of endothelial cells replace normal tissue (Fig. 11). The individual cells are closely packed or separated by small open spaces, thus forming a network which resembles reticulum-cell sarcoma of lymph nodes (Fig. 12). The cells often possess connecting fibrils. The significance of these reticulum-like cells is obscure. Connor believes that Ewing's sarcoma arises from them. The relationship of the reticulum to various cells of the reticulo-endothelial system and their relationship to tumors have been discussed by Waugh, Aschoff, Maximow, and others. Ewing mentions the commingling of endothelial cells and fibroblasts in fibrosarcoma. It is not uncommon, in our series, to find areas of small compressed spindle cells in sections presenting the typical histological picture of Ewing's sarcoma (Fig. 13). There were two instances in which the microscopic findings were not unlike those of lymphoid leukaemia (Fig. 14), and one in which they resembled myeloid leukaemia (Fig. 15). If the classification of Waugh (Fig. 17) is accepted, then a relationship between Ewing's sarcoma and the reticulum cell is unquestionably inferred from our own and from the observations of others. There is a tendency for tumor cells to proliferate around blood vessels in marrow spaces, but we do not consider this sufficient to establish the perithelial lymphatics as the seat of tumor origin. This relationship to blood vessels is by no means constant.

Necrosis was often observed in these tumors. Connective tissue was seen replacing some of these areas of necrosis, and probably accounts for some of the connective-tissue trabeculations and the division of the tumor into lobules, so often seen in typical microscopic pictures of Ewing's sarcoma (Fig. 16). The so-called perithelial arrangement, pseudo-alveoli,

and sheet formation of cells were not uncommon. The many microscopic forms of Ewing's sarcoma are apparently the results of variations in growth and in blood supply, rather than varying modes of histogenesis.

The individual tumor cells were found to vary as frequently as the mode of growth. The commonest type encountered was the small or moderately large round or oval cell, with little or no obvious cytoplasm. The reticulum cell was second in frequency, the spindle type of endothelial cell was third, and the lymphocytic and myelocytic types were rare.

The prognosis is grave. Death occurred in 94 per cent. of the cases in this series. The greatest problem is early and accurate diagnosis, which can be definitely determined only by biopsy. Irradiation, as a therapeutic test, should precede biopsy. Resection of the entire shaft, where possible, in proved cases is the operation of choice; except in the weight-bearing bones of the lower extremity, where amputation is advised.

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# THE USE OF HYDROCHLORIC ACID IN CERTAIN CASES OF ATROPHY AND DELAYED CALCIFICATION IN FRACTURED BONES \*†

BY NELSON W. CORNELL, M.D., ALICE R. BERNHEIM, M.D., AND  
E. COOPER PERSON, M.D., NEW YORK, N. Y.

This is a report of the clinical and roentgenographic observations in five cases of fractured bones in which excessive atrophy of bone and delayed calcification were found about the site of fracture.

Our observations suggest that the bone atrophy was the result of some metabolic or constitutional disturbance affecting the intestinal absorption and subsequent utilization of calcium salts, and was thus responsible for the delayed calcification. There was no evidence of disturbance in the other known factors concerned with the deposition of calcium salts in bone. Parathyroid function was apparently normal; there was no abnormal activity of phosphatase; nor was there any lack of vitamin D or available phosphorus. Other factors necessary for proper healing were also present in these cases, such as:

1. Satisfactory local conditions at the site of fracture:
  - a. Proper reduction of the fracture
  - b. Maintenance of mobilization
  - c. Good circulation
  - d. Absence of severe direct trauma
  - e. Not too frequent roentgenographic examinations;
2. Satisfactory general conditions:
  - a. Absence of serious debilitating disease
  - b. Proper diet
  - c. Good hygiene.

Our evidence indicates that the disturbance in absorption and utilization of calcium was due to decrease or absence of hydrochloric acid in the stomach.

Our procedure and conclusions are based on the following considerations: Absorption of calcium is promoted by factors which tend to keep calcium in solution in the intestine, and *vice versa*. Calcium salts are soluble in acid and relatively insoluble in an alkaline medium. Intestinal acidity is due to hydrochloric acid from the stomach, to fatty acids formed during digestion, and to lactic-acid fermentation. Vitamin D is also associated with the production of intestinal acidity. Zucker and Matzner, Hess and Torrey, and others have shown that the alkaline faeces in tetany are changed to acid upon the administration of vitamin D.

\* Read before the Surgical Section of the American Medical Association, Kansas City, Missouri, May 15, 1936.

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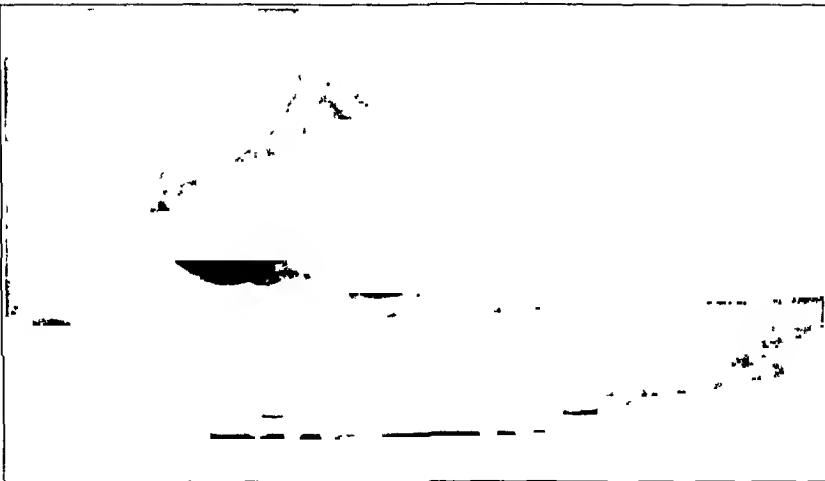


FIG. 1-A

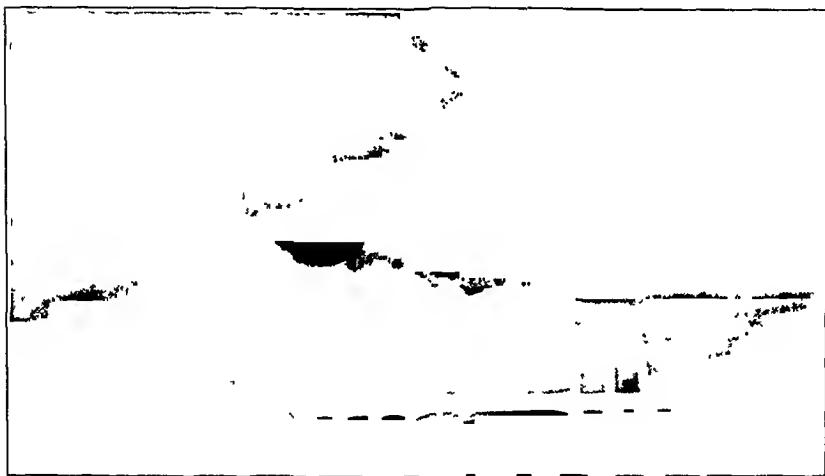


FIG. 1-B



FIG. 1-C

Case 1. Fracture of the femur with Paget's disease. Roentgenogram six and one-half months after operation, showing angulation at the fracture site, no appreciable increase in callus formation, and marked demineralization of surrounding bone. Hydrochloric-acid therapy was begun at this time.

Case 1. Fracture of the femur seven and one-half months after operation and one month after institution of hydrochloric-acid therapy, showing increase in callus with beginning obliteration of the fracture line. The head, neck, and shaft of the bone are beginning to take on a normal appearance.

Case 1. Roentgenogram thirteen months after operation, showing firm union. The bone has a much more normal appearance than before injury.

Apparently, deficiency in any of these factors may lessen intestinal acidity. Telfer's experiments led him to state that "absorption of calcium is initially dependent on the free hydrochloric acid in the stomach".



FIG. 2-A

Case 2. Fracture of the neck of the humerus. Roentgenogram six weeks after operation, showing complete absorption on the outer aspect of the fracture and partial absorption on the inner side. Pain and false motion were present at the fracture site. Hydrochloric-acid therapy was begun at this time.



FIG. 2-B

Case 2. Roentgenogram nine weeks after operation and three weeks after hydrochloric-acid therapy was started. Note reformation of callus to the outer and inner sides. Clinically there was firm union, and solid union eventually occurred.

We use a diet high in calcium and vitamins as a part of our usual treatment of fractures, not only because of the general good effects of a diet enriched by these substances, but also to increase the amount of "available" calcium in the blood. The question might well arise as to the necessity for an increase in the intake of calcium, since with the usual normal calcium content of the blood in these cases there would seem to be no dearth of "available" calcium. In reply, it may be stated that the blood calcium is seldom an indication of calcium behavior. The calcium concentration of the blood remains remarkably constant even when the diet has been deficient in calcium for many years. Lennox and his associates found the blood calcium normal in human subjects starved for twenty-one days. Obviously, this constancy of the blood calcium is maintained largely

through the store in the bones, since ordinarily the diet is variable and intermittent, and, so far as we know, the body does not make calcium. Furthermore, added evidence that normal blood calcium is preserved at the expense of the bones is seen in their demineralization which occurs in long-standing deficiency of calcium intake or absorption. Apparently, the calcium which the bones supply to the blood is not redeposited in the bones, but seems always to be excreted even in instances of great drain, as in pregnancy, hyperparathyroidism, and hyperthyroidism. There is no evidence of a reversible internal circulation of calcium such as exists, for example, in the case of the bile salts. On the other hand, the calcium which is absorbed from the intestinal tract is deposited in the bones. Thus a generous intake of calcium



FIG. 3-A

Case 3. Colles' fracture. Roentgenogram five weeks after reduction. Note the marked spotty demineralization of the carpal and metacarpal bones and of the ends of the radius and the ulna. Hydrochloric-acid therapy was begun.



FIG. 3-B

Case 3. Roentgenogram two months after reduction. The patient had worked two weeks.

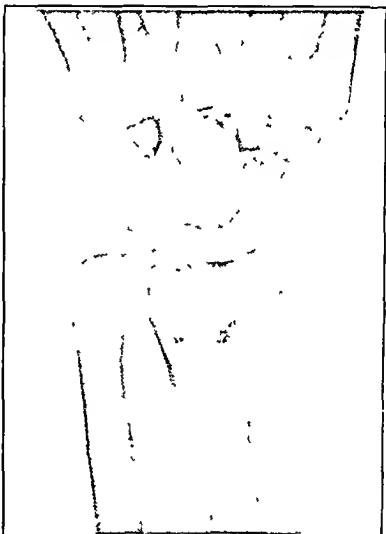


FIG. 3-C

Case 3. Roentgenogram three months after reduction. The carpal and metacarpal bones are returning to their normal appearance. The patient worked without pain or stiffness.

seems indicated in cases of fracture when there is special need for the deposition of calcium in the bones. However, in the presence of achlorhydria or hypochlorhydria, increase in the intake of calcium and vitamin D is apparently insufficient for the proper utilization of calcium, and in these instances the addition of hydrochloric acid is indicated. Jones produced rickets in puppies by a diet adequate except for its high alkalinity, and cured rickets in children on a similar diet by the addition of hydrochloric acid.

#### SCHEDULE OF TREATMENT

##### 1. High-Calcium, High-Vitamin Diet:

Breakfast:	<i>Required Food</i>	<i>Other Food Allowed</i>
	Orange or grapefruit juice	Any fruit (raw or cooked)
	Wheat germ (Bemax or Embo), one to two tablespoons	Coffee or tea, with sugar and cream
	Milk, one pint	Bread, one slice; or a roll, with butter

Mid-Day Meal:	<i>Required Food</i>	<i>Other Food Allowed</i>
	Milk, or buttermilk, one pint	Cheese
	Vegetables (except potatoes, rice, spaghetti, corn)	Eggs *
	Fruit	Bread **, one slice, or a roll, with butter

Evening Meal:	<i>Required Food</i>	<i>Other Food Allowed</i>
	Tomato juice (any good canned variety, not the prepared cocktail; seasoning may be added) or pineapple juice	Any other foods desired
	Meat or fish	

Nothing should be eaten between meals.

There should be intervals of at least five hours between meals.

##### 2. Vitamin D: (1900 units, U. S. P. XI). Cod-liver oil or tablets may be used. Vitamin-A and vitamin-D tablets, six a day, are taken in two doses of three tablets each, before meals.

##### 3. Lactose: About 100 grams (from four to six tablespoonfuls) may be taken in milk or in any way desired (uncooked). Lactose may cause excessive gas or diarrhoea. In case of the latter, the dose should be reduced and then gradually increased. The excessive gas usually disappears in the course of a week or two. Beta lactose is preferable to the alpha form because of its greater solubility, but either may be used.

##### 4. Calcium: If milk is taken as prescribed in the diet, one dose of calcium lactate, two and six-tenths grams (forty grains), or calcium gluconate, five and two-tenths grams (eighty grains), should be taken once a day, no nearer meals than four hours after and one hour before. If no milk is taken, three such doses are required, one dose being equivalent in calcium to one pint of milk.

##### 5. Hydrochloric Acid: (10-per-cent. solution), four to eight cubic centimeters in water, fruit juice, or milk, with meals.

\*Eggs may be taken at breakfast, if preferred.

\*\* One starchy vegetable may be substituted for bread.

It is to be noted, however, that the use of hydrochloric acid without the proper calcium intake may be harmful, since hydrochloric acid besides furthering the utilization of calcium also increases its excretion.<sup>6</sup>

The schedule of treatment, as shown on page 44, is arranged in accordance with certain factors which favor calcium absorption. A full discussion of this regimen is contained in a previous paper.<sup>1</sup>

Gastric analysis was carried out in twenty cases of fracture. In twelve of these cases, the findings were normal, and normal healing occurred. In eight cases, gastric acidity was either absent or low, and was associated with diminished volume of gastric contents. In these eight cases, healing did not occur with the usual method of treatment. Our present report is on only five of these cases, since three could not be properly followed.

The gastric analyses were done by Dr. E. Cooper Person. The method used was that of Bloomfield and Pollard, in which determinations are made after the administration of histamine. The normal standard for various ages as described by these authors was used. The normal mean acidity will be given with each case report.

#### CASE REPORTS

**CASE 1.** A. M. (No. 74688), a policeman, aged fifty-one years, was admitted to the New York Hospital, on September 13, 1934, with a subtrochanteric fracture of the right femur following a fall. Russell traction was applied, and the deformity was overcorrected. In addition to the fracture, roentgenographic examination showed exceedingly dense bone with the appearance of Paget's disease. Roentgenograms of the skull showed a typical picture of osteitis deformans.

Open reduction was done five days after the injury. A Lane plate was applied, and also a plaster spica from the axilla to the toes. The spica was removed on the fifty-sixth day, and a walking caliper splint was used on the seventy-seventh day. At this time there was poor callus formation with incomplete bony union. There was no additional callus formation at the end of five months. Treatment had consisted of the dietary regimen, heliotherapy, and walking. At this point, gastric analysis showed the following:

#### *Minutes after Histamine Injection*

	10	20	30	Mean	Average Normal Mean (for This Age)
Free hydrochloric acid.....	17	20	10	15.2	
Total acidity.....	18	34	20	24.0	91.1
Volume of gastric contents.	12 c.c.	26 c.c.	20 c.c.	19.1 c.c.	36.8 c.c.

Hydrochloric acid (four to eight cubic centimeters of a 10-per-cent. dilute solution, with meals, three times a day) was added to the regimen. In one month marked increase in bony callus was seen, which continued until the fracture line was completely obliterated, one year after the injury. Decrease in the abnormal density of the bone was also noted. The patient returned to work at the end of ten months.

**CASE 2.** J. G. (No. 19320), a tall, thin girl, aged nineteen years, was admitted to the Hospital on August 10, 1935, with an injury to the right shoulder, following a fall from a horse. Roentgenographic examination showed a fracture of the surgical neck of the right humerus with the head rotated anteriorly and the shank displaced laterally. An unsuccessful attempt at closed reduction was followed sixteen days later by an open

reduction. Reduction was difficult. The fragments were fixed with chromic catgut through drill holes, and a plaster-of-Paris spica was used with the arm in abduction and external rotation. By the fifth week, there was frail bony callus with apparent union, and the cast was removed. Two weeks later, severe pain was experienced at the fracture site, where false motion could be felt. Roentgenographic examination showed absorption of callus. At this time, gastric analysis showed only slightly reduced acidity for the patient's age and low volume of the stomach contents.

*Minutes after Histamine Injection*

	10	20	30	Mean	Average Normal Mean (for This Age)
Free hydrochloric acid.....	30	60	70	53.1	
Total acidity.....	40	70	74	61.1	85.1
Volume of gastric contents.	15 c.c.	22 c.c.	18 c.c.	18.1 c.c.	34 c.c.

Nevertheless, hydrochloric acid (four to eight cubic centimeters, three times a day) was added to the dietary regimen. Three weeks later, roentgenographic examination showed remarkable deposition of callus. Bony callus continued to increase under this therapy until the patient had an excellent functional and anatomical result. In addition, the patient states that her general health is much improved since taking the hydrochloric acid.

CASE 3. A. McS. (No. 109007), a woman, aged fifty years, was admitted to the Hospital on September 24, 1935, with a fracture of the base of the left radius. The fracture was reduced, and the patient was put on the dietary regimen. In three weeks, the wrist seemed solid, and the splints were removed, but roentgenographic examination revealed marked demineralization of the carpal bones. Gastric analysis showed no free hydrochloric acid and reduced volume of stomach contents.



FIG. 4-A

Case 4. Subtrochanteric fracture of the neck of the right femur in a woman of sixty-six, with Paget's disease of the bone. The patient was put on a high-calcium and vitamin diet and hydrochloric-acid therapy was started at once.

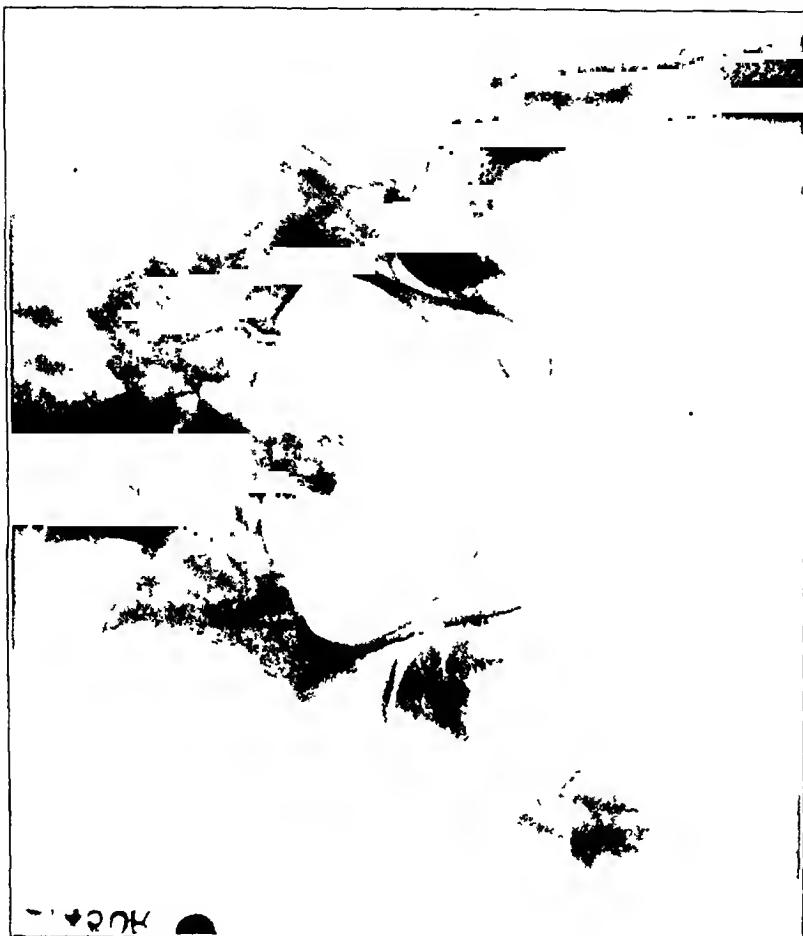


FIG. 4-B  
Case 4. Roentgenogram three weeks after fracture. Note that bony callus and demineralization are beginning to appear.



FIG. 4-C  
Case 4. Roentgenogram two months after fracture. Note the large amount of callus and marked demineralization of the surrounding bone as compared with Case 1. Hydrochloric-acid therapy was continued.

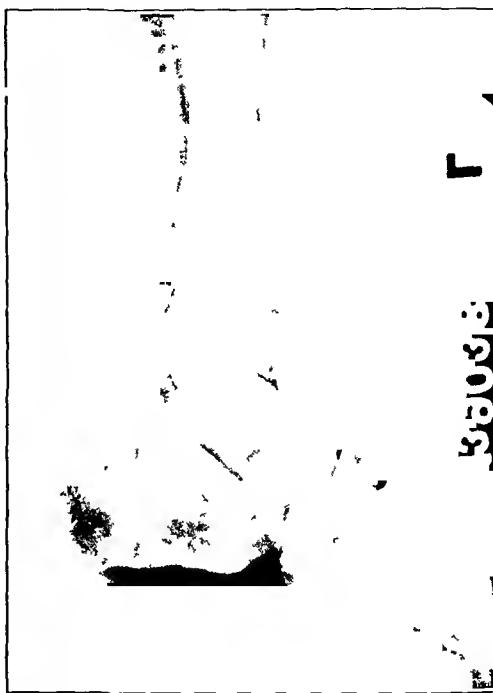


FIG. 5-A

Case 5. Comminuted fracture of the fibula and fracture of the medial malleolus of the tibia. Roentgenograms three months after reduction, showing non-union of the fibula and spotty osteoporosis of the tarsal bones and of the lower end of the tibia and fibula. Hydrochloric-acid therapy was begun.

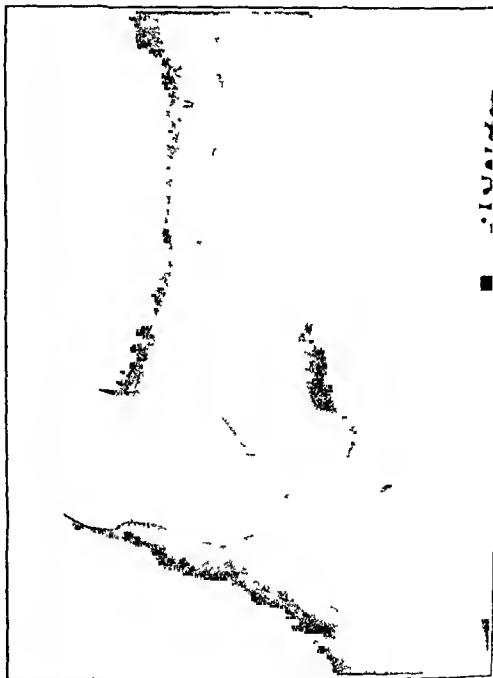


FIG. 5-B

Case 5. Roentgenograms four months after reduction and one month after hydrochloric-acid therapy was begun, showing that the osteoporosis is beginning to disappear. This is best seen in the lateral view.

*Minutes after Histamine Injection*

	10	20	30	Mean	Average Normal Mean (for This Age)
Free hydrochloric acid.....	0	0	0	0	
Total acidity.....	2	3	6	3.2	78.7
Volume of gastric contents.	12 c.c.	7 c.c.	8 e.c.	9 c.c.	27.6 c.c.

Under the administration of hydrochloric acid, calcification of the bones occurred with extraordinary rapidity. The patient returned to work as a maid six weeks after the fracture, without pain or stiffness in the wrist and hand.

CASE 4. M. E. F. (No. 121450), a woman, aged sixty-six years, was admitted to

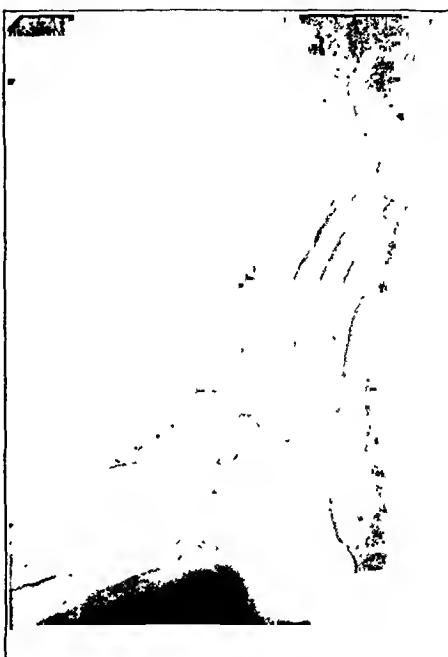


FIG. 5-C

Case 5. Roentgenograms eight months after reduction and five months after hydrochloric-acid therapy was begun. The osteoporosis has disappeared and the clinical symptoms are much improved.

the Hospital on February 7, 1936, with a fracture of the femur from a fall down a flight of stairs. Roentgenographic examination showed a transverse fracture of the upper third of the right femur and heavy deposits of calcium throughout the bone, suggesting osteitis deformans. Modified Russell traction was instituted. Gastric analysis showed:

*Minutes after Histamine Injection*

	10	20	30	Mean	Average Normal Mean (for This Age)
Free hydrochloric acid.....	6	30	10	15.1	
Total acidity.....	20	40	15	24.3	78.7
Volume of gastric contents.	10 c.c.	20 e.c.	3 c.c.	11 c.c.	27.6 c.c.

Treatment with the dietary regimen and hydrochloric acid was started immediately. Four weeks later, roentgenographic examination showed considerable callus about the

site of fracture and disappearance of the heavy calcium deposits in the femur. In eight weeks, union was firm and the traction apparatus was removed. One year later, the result was excellent.

CASE 5. M. O. (No. 139038), a woman, aged forty-five years, was admitted to the Hospital on July 16, 1936. Four hours before admission she had fallen down a flight of stairs and had turned her left ankle outward. Roentgenographic examination showed fracture of the tibia through the medial malleolus and an oblique fracture of the fibula at the junction of the lower and middle thirds. Fragmentation of the fibula and considerable displacement of the talus were noted. Reduction was done under local anesthesia, and a skin plaster was applied. One week later, a Böhler walking iron was incorporated in new plaster. One month later, roentgenographic examination showed poor callus formation. A padded plaster was then applied; this was removed six weeks later, when another roentgenographic examination showed poor callus formation, osteoporosis, and non-union of the fibula. There was marked swelling of the ankle and foot.

Gastric analysis in this case was for total acidity only, after histamine injection. This was found to be 43, while the average normal mean for the patient's age is 75. Hydrochloric acid was then added to the regimen. One month later, there was distinct improvement in callus formation. Still further improvement, with decrease in the osteoporosis and in the swelling of the ankle and foot, was noted three weeks later. Final examination, one year after the accident, showed an excellent result with normal calcification and no swelling.

#### SUMMARY AND CONCLUSIONS

Reduced gastric acidity and decrease in the volume of gastric contents were observed in eight cases of fractured bones in which excessive bone atrophy and delayed calcification were found about the sites of fracture. Five of these cases were treated and followed.

Our findings and experience in these cases lead us to conclude that the addition of hydrochloric acid (four to eight cubic centimeters of a 10-per-cent. solution, three times a day) to a diet high in calcium and vitamins increases the absorption of calcium and furthers the calcification of bone.

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# THE COMPENSATION-DEROTATION TREATMENT OF SCOLIOSIS \*

BY A. STEINDLER, M.D., F.A.C.S., IOWA CITY, IOWA

*Professor of Orthopedic Surgery, The State University of Iowa*

IN COLLABORATION WITH WILLIAM R. HAMSA, M.D., OMAHA, NEBRASKA,  
AND WILLIAM COOPER, M.D., IOWA CITY, IOWA

The development of scoliosis represents a succession of changes, which, in all but the truly congenital type, are open to observation. While the deformity is continuous in its development, although not uniformly so, certain mechanical features project themselves more or less conspicuously during the course. One might, therefore, speak of steps or phases, except that there is a good deal of overlapping about them and they do not represent strictly chronological units.

Following the prodromal attitudinal period is the primary curve, which develops by inclination or by translatory shift in the frontal plane and by convex side rotation in the transverse plane. Rotation and lateral deviation cannot be dissociated. They are integral parts of the same process of deformation, and their interrelationship is predicated mechanically and anatomically by the construction of the spine as an articulated rod with anteroposterior triple curving, and by the fact that the gliding motion from vertebra to vertebra is preordained by the arrangement of the intervertebral articulation.

In the second stage, nature endeavors to maintain the normal relationship between body and pelvis by the formation of the usual lumbar counter curves, which show the same obligatory combination of lateral bend and convex side rotation, except that the lumbar spine is freer to undergo a translatory side shift than is the thoracic spine; the latter is anchored into the thoracic cage and, therefore, its lateral deviation is more of the inclinatory type.

In both stages, the normal relationship between the trunk and the pelvis and lower extremities is preserved as a whole, and the trunk rests squarely upon the pelvis.

In the third stage, this relationship is becoming lost. The trunk, on the one hand, and the pelvis and lower extremities, on the other, undergo a translatory movement against each other in the opposite direction. If a compensating curve is present, it is entirely inadequate and the trunk pivots in the sacrolumbar junction over to the convex side, producing the overhang, with elevation of the shoulder on the side of the primary convex curve and protrusion of the hip on the side of the primary concave curve; if the pelvis is included in the lumbar curve, a pelvic obliquity also develops. The movement is primarily a translatory one, but it is at the same time associated with an accentuation of the primary curve. (See Figure 1.)

\* Read at the Annual Meeting of the American Orthopaedic Association, Atlantic City, New Jersey, May 5, 1938.

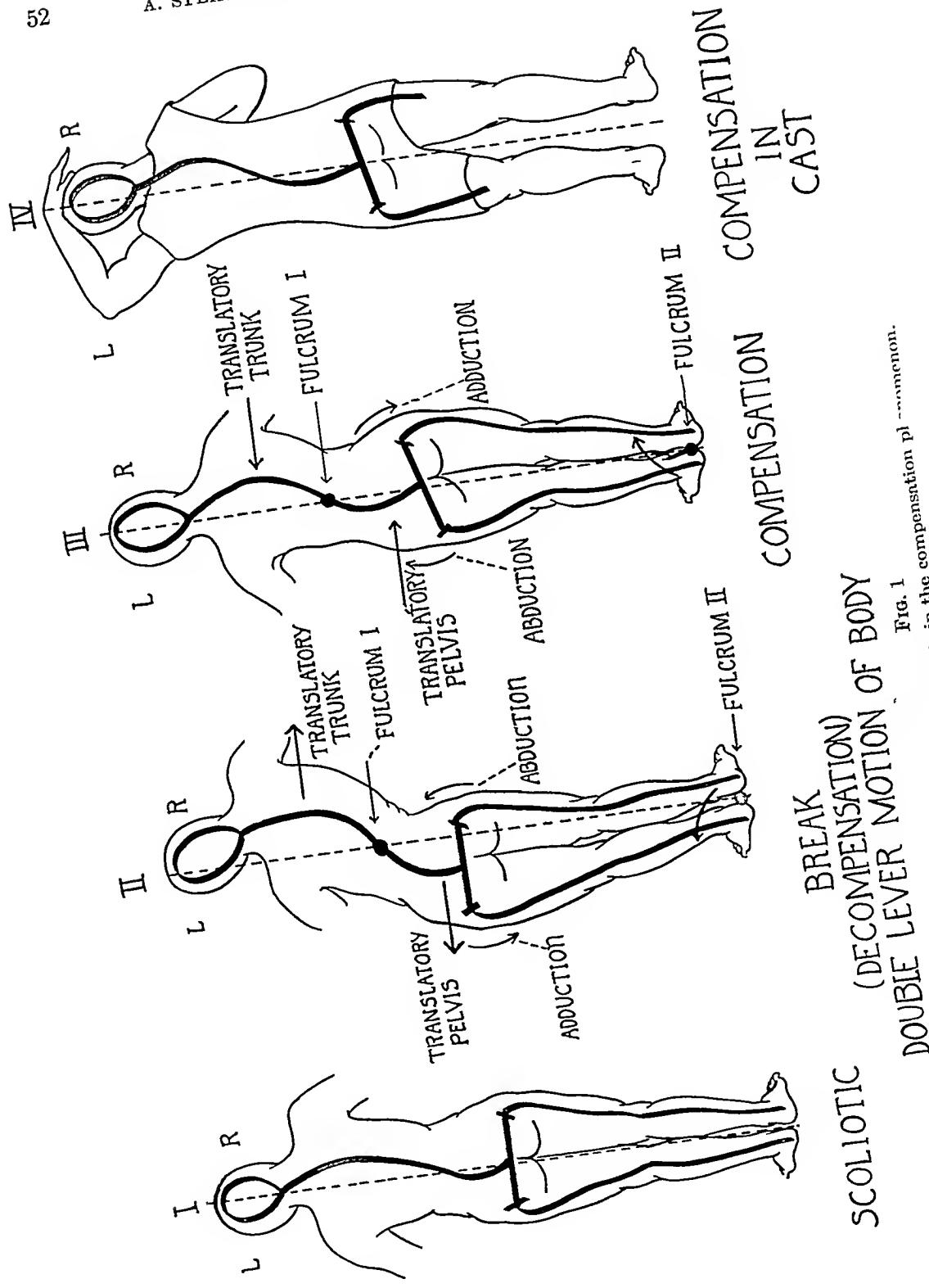


Fig. 1 Diagram illustrating stages in the compensation phenomenon.

## RESULTS OF TREATMENT IN NON-PARALYTIC SCOLIOSIS

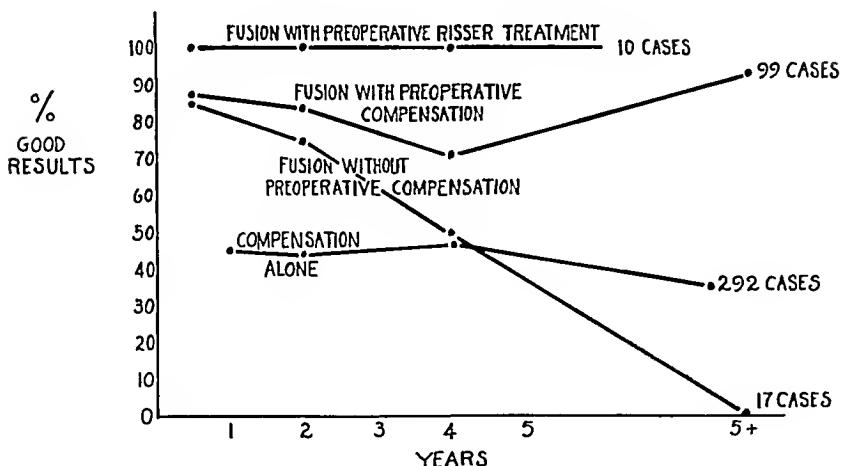


FIG. 2

Graph showing results of treatment in non-paralytic scoliosis. In the 109 cases of fusion with preoperative compensation or Risser treatment, the deformity showed no tendency to progress during the entire period of observation. In the seventeen cases in which fusion was done in the uncompensated state, the correction of the deformity was not maintained during the same period. In approximately 40 per cent. of the 292 cases, treated by the compensation method alone, the compensation was consistently retained during an observation period extending over twelve years.

The question arises: Do all cases in the natural course go on to the state of decompensation, and, if so, when is it natural for the progression of the deformity to be arrested? We believe with Risser that most cases come to a natural halt at the completion of growth—that is, about the twentieth year—although there are severe rachitic, congenital, and, especially, paralytic deformities which increase beyond this age limit.

We further believe that most cases pass on from the compensation to the decompensation stage. There are cases, however, although not many, which come to a natural arrest before the end of the growth period is reached, and before natural compensation is lost.

When the compensation treatment for scoliosis was introduced twelve years ago, the idea was to retrace nature's steps from the decompensated to the compensated stage, on the supposition that, if a natural arrest of scoliosis in the state of compensation could occur, the same might be accomplished artificially by restoring the state of compensation. Not sharing the prevailing defeatist attitude that in every case of scoliosis fusion should be done, we proceeded to select for the treatment of compensation those cases in which it seemed reasonable to suppose that the patients could maintain themselves in the erect position by their own muscle control when they were restored to the state of compensation. It appears now, after twelve years of observation, that the original field of indication was drawn too wide and that only 40 per cent. of the patients treated by compensation methods alone were able to maintain themselves

in the compensated position and without further progression of the deformity during the twelve-year observation period. (See Figure 2.)

On the other hand, it became quite evident that the success of fusion depends very largely upon the degree of spinal compensation obtained before fusion is carried out. In other words, when fusion was done in cases in which adequate compensation had not been previously obtained or was not obtainable, the position of fusion could not be maintained, and the deformity progressed; whereas, when fusion was carried out in cases in which satisfactory compensation had been obtained, the state of compensation was maintained during the twelve-year observation period. (See Figure 2.)

A feature of decompensation is pelvic obliquity. It represents the inclusion of the pelvis either in the lumbar curve or in an occult, sacral counter curve (paradox scoliosis). Correction by traction or myotomy is part of the compensation proceedings.

It will be noted that with the compensation treatment no absolute correction of any curve is accomplished. It is claimed for the inclination method of correction by hinged plaster-of-Paris jackets that a straightening of the curve by purely lateral bending is obtained, but it



FIG. 3-A



FIG. 3-B

Fig. 3-A: The Risser cast. The hinges are anterior and posterior over the apex of the primary curvature.

Fig. 3-B: Roentgenogram showing short sharp curve. Correction by Risser cast can only be obtained by accentuating the compensatory curves.

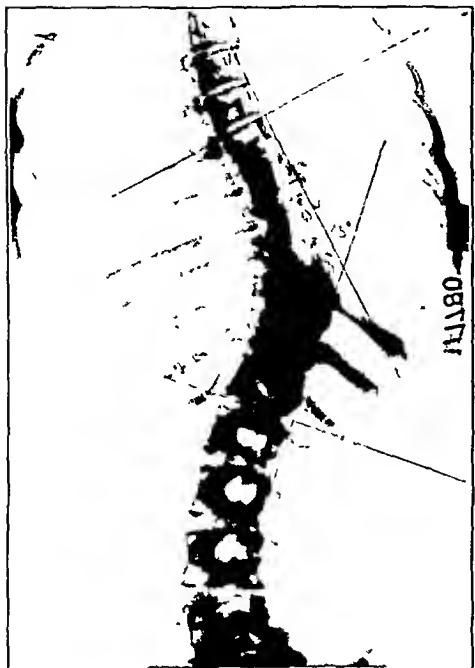


FIG. 4-A



FIG. 4-B

Roentgenograms showing derotation of the lumbar spine.

FIG. 4-A: Anteroposterior view of the entire spine with the patient supine.

FIG. 4-B: Anteroposterior view of the lumbar spine, showing derotation effect on the lumbar spine of rotating the thorax. In this case, the thorax was rotated anteriorly on the left.

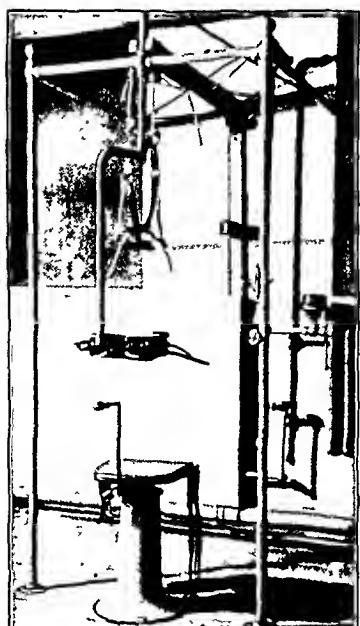


FIG. 5-A



FIG. 5-B

The Grieve derotation chair.

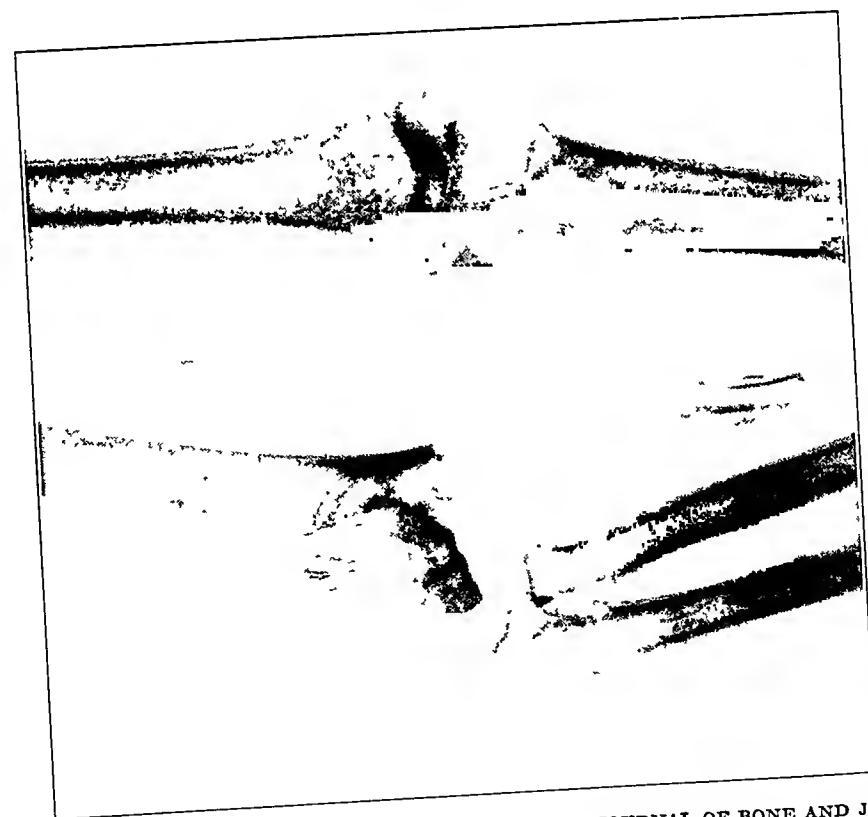


FIG. 2-A  
Case J. K. May 9, 1927. First transcondylar fracture treated by lateral traction as a means of reduction. Notice that the fracture line passes through the olecranon fossa. Because of overlapping, the typical fish-tail appearance of the lower end of the upper fragment is not shown.

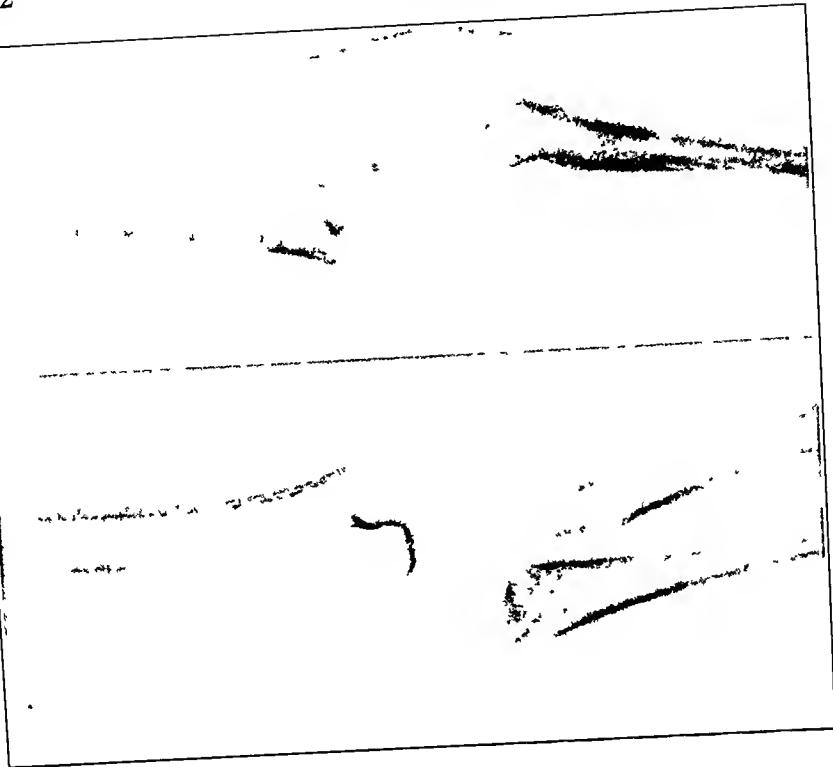


FIG. 2-B

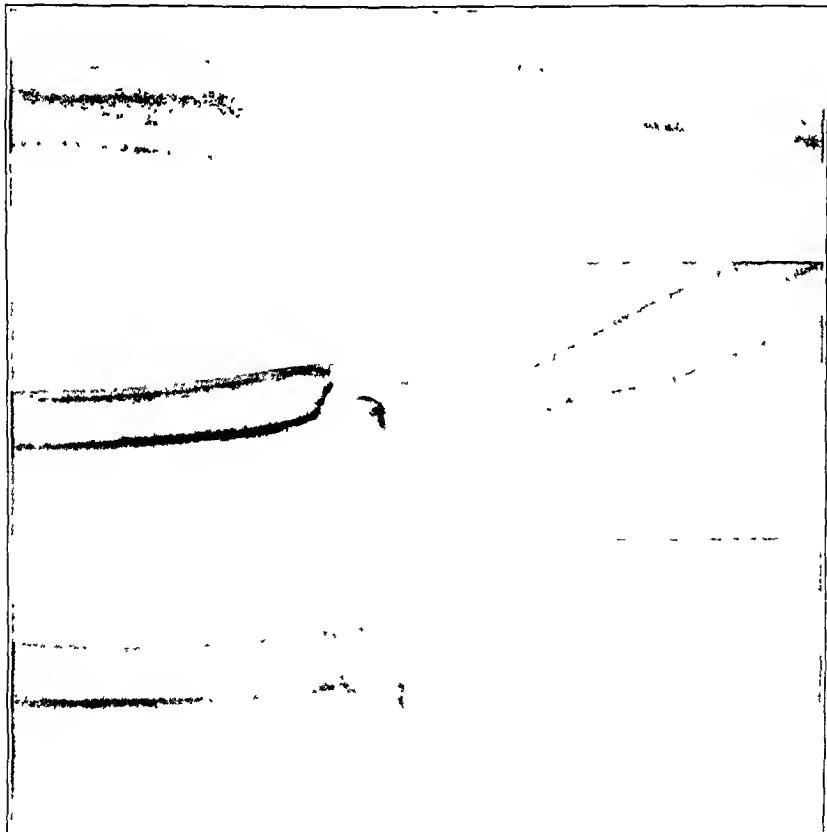
Case J. K. May 10, 1927. After application of traction. The fracture line is now clearly seen passing through the olecranon fossa. Sufficient weight has not yet been applied to separate the fragments and to allow them to be molded into correct alignment.

FIG. 2-D

Case J. K., May 19, 1927. Ten days after injury; The anteroposterior view shows perfect alignment and excellent restoration of the olecranon fossa. The lateral view shows a bowing forward of the humerus at the fracture line, but otherwise the alignment is good.

FIG. 2-C

Case J. K., May 12, 1927. Alignment considerably improved in the first two days of traction. In comparing the two lateral views, note the improvement immediately after addition on the same date of extra weight to the sling about per arm.



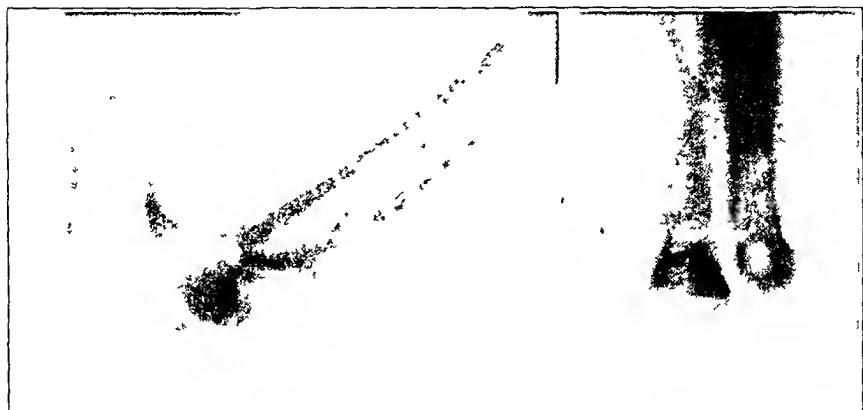


FIG. 2-E

Case J. K. May 21, 1927. The anteroposterior view is of great importance, for it demonstrates the position of the fragments after flexion of the elbow for further treatment. In those cases where rotation persists between the fragments, an offset will be noticed.

Having previously experienced difficulty with transcondylar fractures, the author decided to apply the first principle of fracture reduction to



FIG. 3

Case L. P. Anteroposterior roentgenogram showing the type of case to which this method of reduction and treatment is applicable. The fracture line passes directly through the olecranon fossa and the wide portion of the lower end of the humerus.

this type of fracture,—namely, traction which would include the lateral molding action of the tensely stretched muscles, which the writer concluded was the reason he had obtained such exact reposition of the fragments in the case just cited.

Figures 2-A through 2-E are roentgenograms of the first case of transcondylar fracture treated by straight-arm traction. In this case, a period of from one to two days elapsed between roentgenograms, a period of time thought necessary for the changes to take place following some adjustment in weights, etc. These roentgenograms represent only a part of those made in the experiment, but are shown with the idea of depicting the difficulties which will be encountered in the application of this method, and of forewarning against consequent discouragement.

In this first case of transcondylar fracture, the author learned that the reason perfect reductions were improbable by the use of the Jones

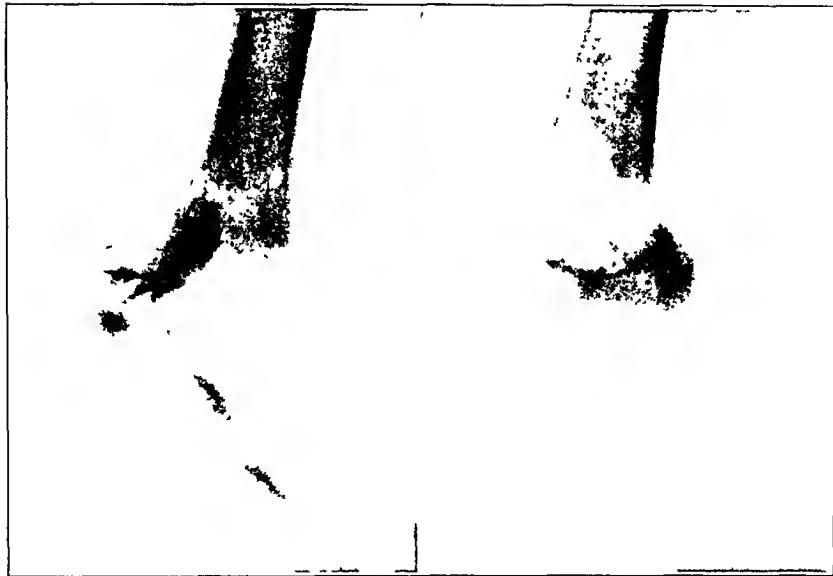


FIG. 4

Case H. B. April 12, 1936. Anteroposterior roentgenograms on admission. The fork-like outline of the distal end of the upper fragment of the humerus is typical of the transcondylar fracture. The oval central portion is the result of the passing of the fracture line through the olecranon and coronoid fossae.



FIG. 5

Case R. L. January 14, 1937. The diagnostic roentgenograms of a perfect example of a transcondylar fracture, showing the typical fishtail shape of the lower end of the upper humeral fragment. The fracture extends transversely across the olecranon fossa. Note wide separation of fragments in lateral view. This case was successfully treated by straight-arm traction.

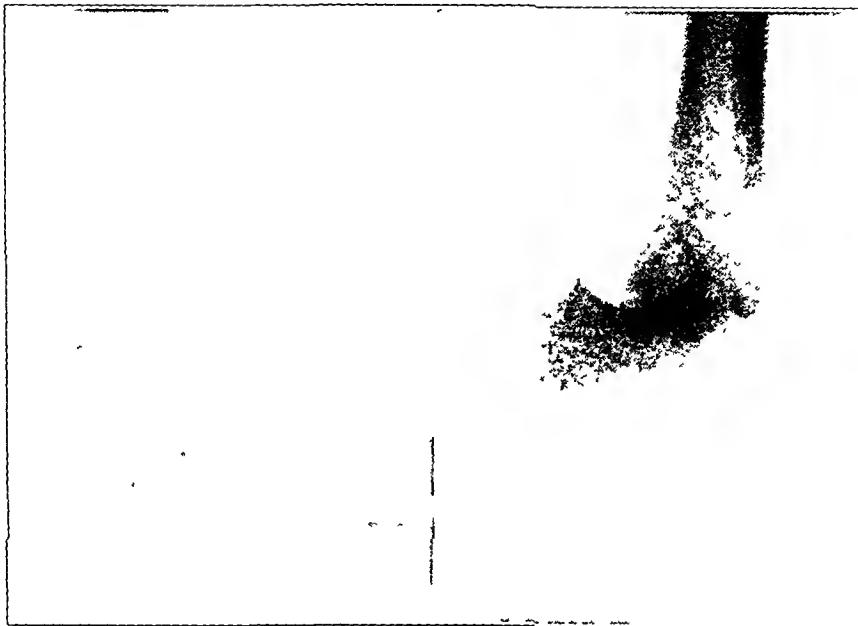


FIG. 6

Case F. B. Lateral and anteroposterior views of a typical transcondylar fracture, the type which the author believes cannot be treated successfully by manual reduction in the acute flexed position. Notice the fishtail shape of the lower end of the proximal fragment, due to the passing of the fracture line through the olecranon fossa.



FIG. 7

Case F. B. Bad end results of an improperly treated transcondylar fracture. The olecranon fossa is obliterated by lateral displacement of the distal fragment, which prevents straightening of the elbow. The shaft of the humerus extends anteriorly, due to rotation of the distal fragment on the proximal fragment. This deformity means restriction of flexion of the elbow joint.

position was twofold: first, the upper and lower fragments become rotated in their relation to each other; second, the fracture surface at that particular level consists of an extremely narrow edge, rarely more than from three to five millimeters in thickness, which, due to the usual mechanism of the fracture, is bevelled like a chisel.

When one attempts to maintain reduction of such a fracture, the distal fragment slips posteriorly, due to the pull of the strong triceps muscle. If, however, the distal fragment is rotated, it will hook onto the proximal fragment and will not slip. This is especially true if the thin portion of the bone forming the olecranon and coronoid fossae is crushed and forms a notched area, which helps to lock the fragments together.

Many so-called reductions are, therefore, obtained by a rotation resulting in this locking of the fragments. The roentgenograms of such a reduction disclose what has taken place to hold the fragments and to prevent their slipping. When this type of reduction is obtained, deformity is sure to result. Either the slipping into rotation occurs and destroys the carrying angle, or the malposition does one of two things: it places the rotated proximal fragment of the shaft of the humerus so far forward that it produces a bone block to prevent flexion, or, what is perhaps more serious, it destroys the contour of the olecranon and coronoid fossae, either by the change in their shape or by the deposition of new bone, due to the repair process, so that the normal action of the joint in flexion and in extension is impossible. This also is a bone block, but is not so readily recognized in the roentgenograms. The result is impaired movement with deformity.

Figures 3 through 7 are typical of the transcondylar fractures of the humerus with which this article is concerned. All show the typical fish-tail shape of the lower end of the proximal fragment, which is always diagnostic and should indicate that lateral-traction treatment should be immediately instituted. In each case, incorrect treatment resulted in deformity and restriction of function.

Figures 8-A and 8-B show the simple apparatus, which, if used precisely as recommended by the writer, will, in the great majority of cases, give most satisfactory end results.

Formerly, days were required to accomplish a reduction. The author now finds that it can be done in about twenty-four hours, with much more accuracy. This method requires the very closest attention of the surgeon, and he must fully understand each step of the procedure. The following is the procedure:

1. A correct interpretation of the type of fracture from the roentgenograms.
2. Admission of the patient to a hospital where the procedure can be fully followed. In addition to the simple apparatus, one must have access to a portable x-ray unit.
3. Administration of morphine hypodermically to obtain relaxation and to allow the necessary movement of the arm.

4. Application of traction to the arm up to the elbow joint.
5. Gradual straightening of the arm and attachment of the weights to the traction apparatus.
6. Elevation of the side of the bed toward the traction.
7. Attachment of a binder or sheet about the body of the patient to hold him in bed, as there is a tendency for the patient to slide toward the weights.
8. Taking of anteroposterior and lateral roentgenograms within approximately half an hour. Much can be learned from these films as to:
  - a. Amount of weight necessary.
  - b. Elevation of pulley on standard.
  - c. Necessity for use of counter-weight with sling over upper arm.

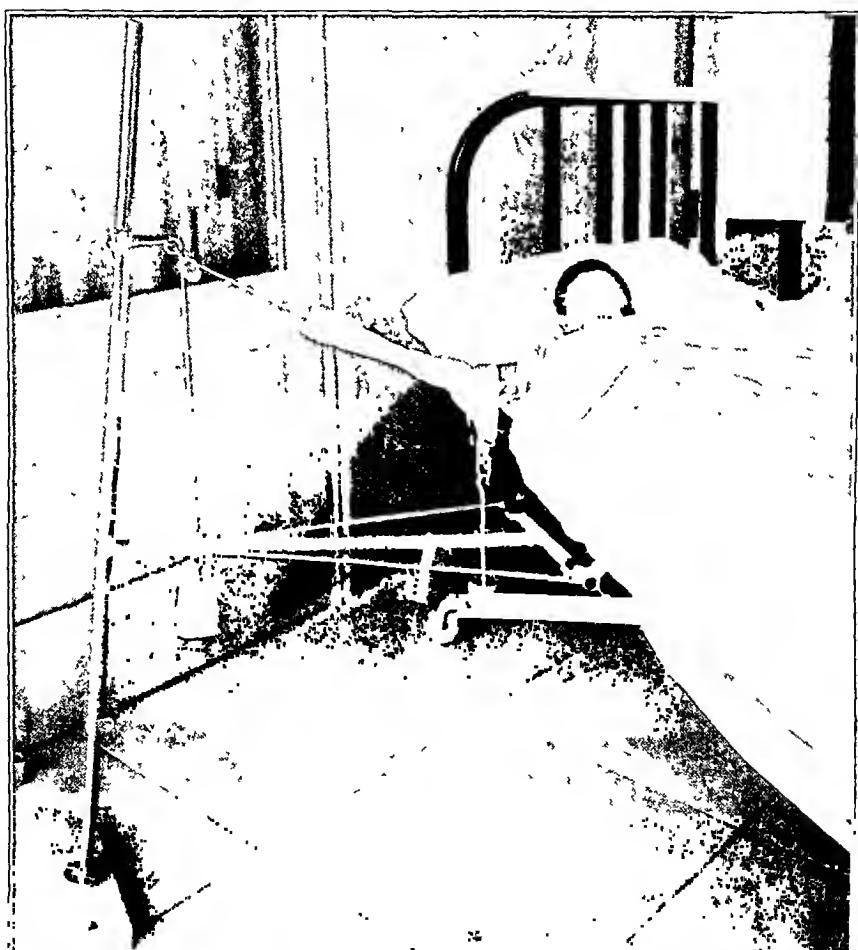


FIG. 8-A

Apparatus used in the first cases treated. It clearly shows the straight traction and lateral counter-traction about the upper arm. It was found later that if the pulley is placed at a higher level, as shown in Fig. 8-B, the distal fragment is more readily pulled forward into position. This is clearly illustrated in the roentgenograms of Case B. R., in which reduction was effected in twenty-six hours, and in which the higher elevation was used.

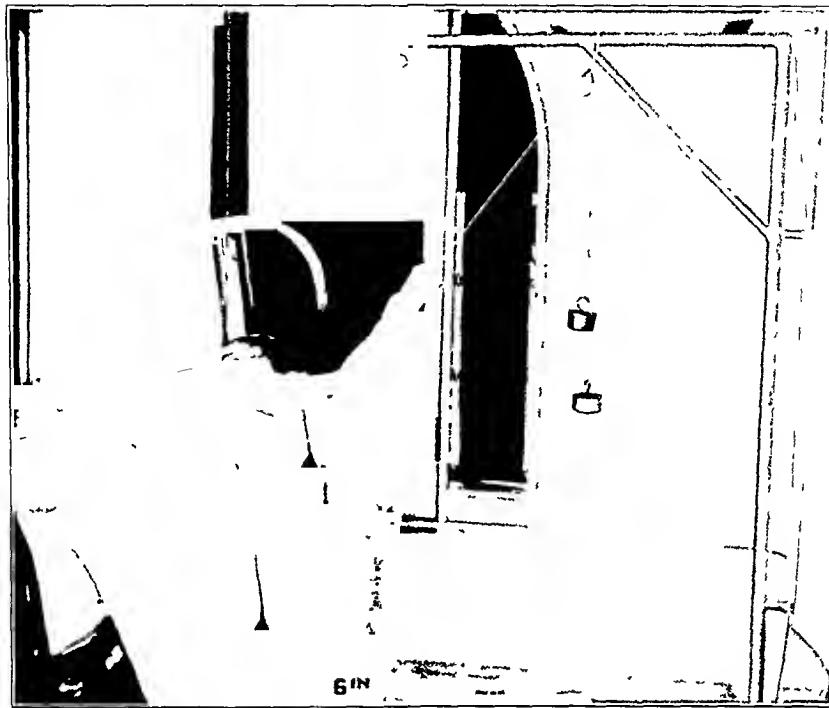


FIG. 8-B

Apparatus used in twenty-six-hour reduction. Note the following: (1) child in tipped bed with sheet around body pinned to opposite side of bed; (2) stand with sufficient elevation, to which traction is attached; (3) traction applied to forearm; (4) counter-traction about upper arm.



FIG. 9-A

Case B. R., a boy, aged seven years. Showing transcondylar fracture a half hour after injury.

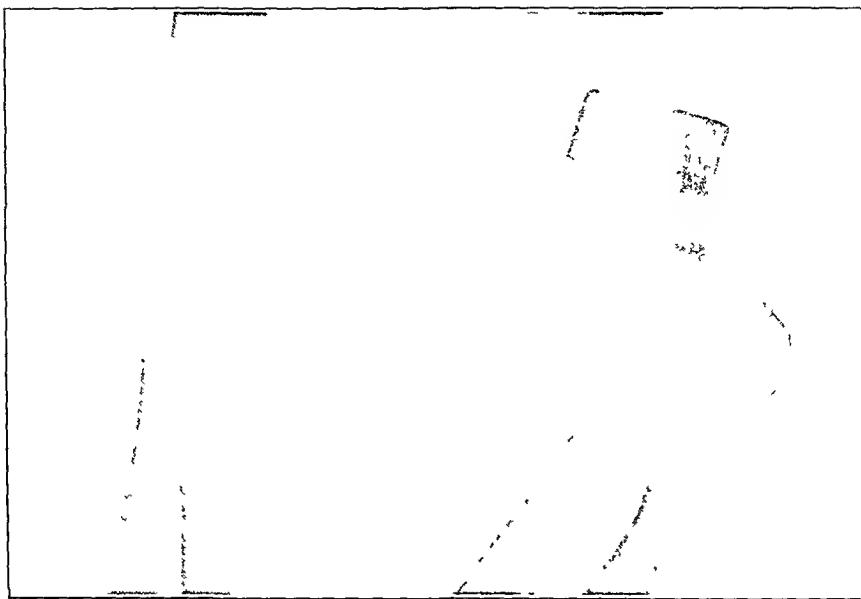


FIG. 9-B

Case B. R. Showing position of fragments two and one-half hours after application of traction.

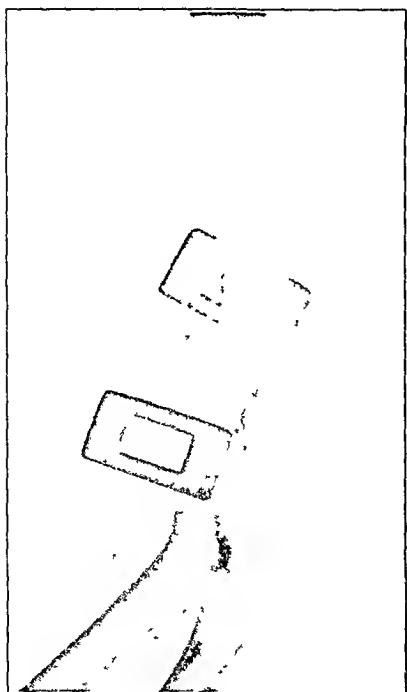


FIG. 9-C

Fig. 9-C: Case B. R. Lateral view, nineteen hours after application of traction. The sling with counter-weight was placed on the shaft of the humerus five hours after traction was originally applied. Since the distal fragment was still angulated backward slightly, the forearm was further elevated. (See Fig. 8-B.)

Fig. 9-D: Case B. R. Lateral view, twenty-six and one-half hours after application of traction and five and one-half hours after elevation of forearm, showing perfect alignment of distal fragment with proximal fragment.



FIG. 9-E

Case B. R. After removal of traction, the arm was flexed to about 80 degrees without force, and plaster fixation was applied, to be worn from two to three weeks. Notice the realignment which took place as the arm was flexed for the permanent splinting

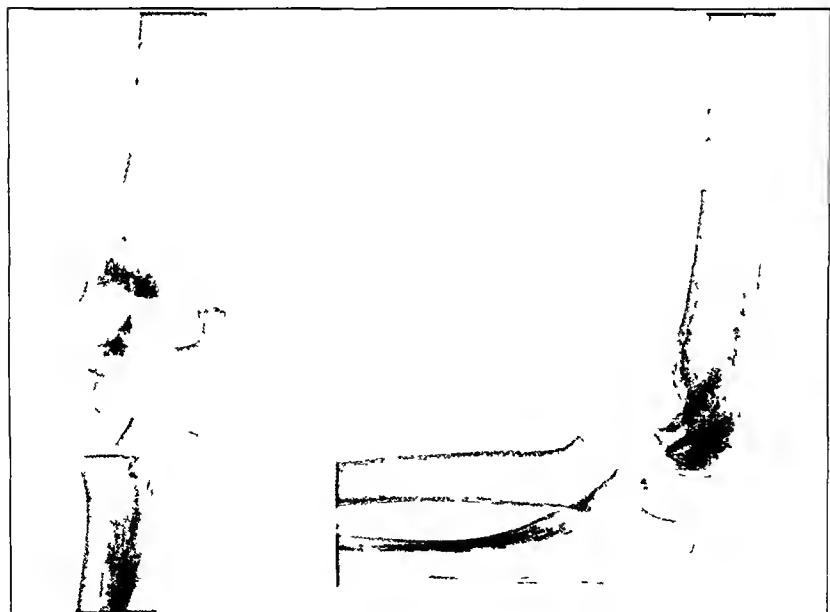


FIG. 9-F

Case B. R. April 6, 1938 Last films four months after injury. The bone repair is well advanced, although healing is not complete. Alignment is excellent, and function is normal.

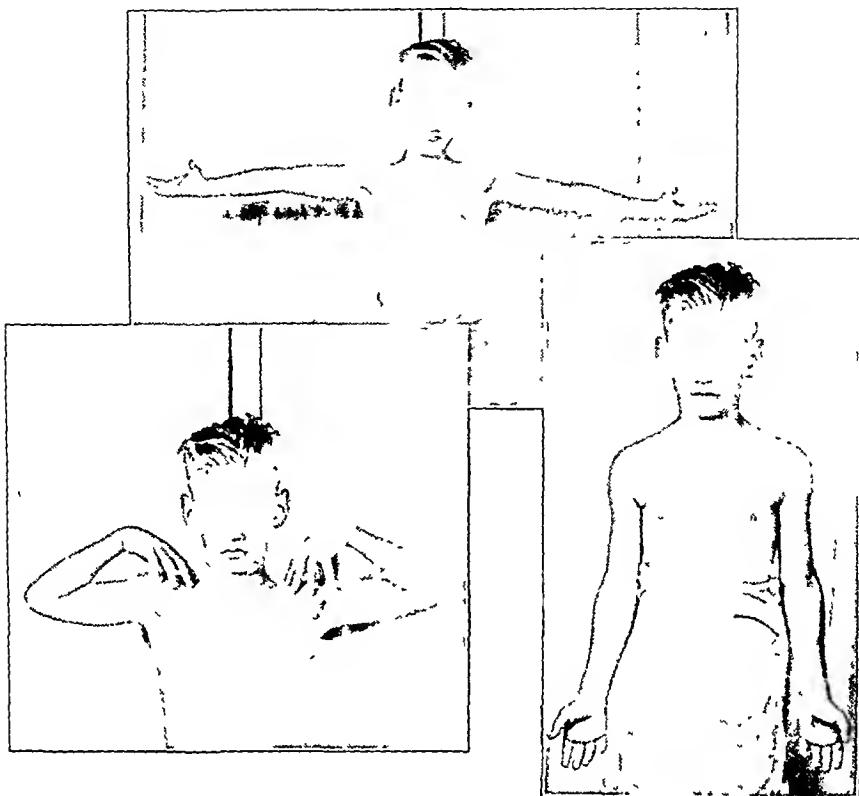


FIG. 9-G

Case B. R. Photographs showing capacity to flex and to extend the elbow, and a comparative view showing preservation of carrying angle.

9. Taking of additional roentgenograms in about three or four hours, which will indicate whether there should be an increase in the weight used, or a change in the angle of traction.

10. Judicious rearrangement of the traction to obtain good alignment, with the patient completely relaxed by morphine sedation. Formerly, the author considered it necessary to manipulate the arm under gas anaesthesia to obtain a satisfactory reduction after traction had been applied for a few days. However, with the use of a sedative, reduction is well on its way within a few hours, and it should require not more than twenty-six hours to complete the reduction.

11. Removal of traction and application of splint and sling. When the roentgenograms show sufficient callus, and the fragments appear to be firmly united, the traction is removed, while the surgeon holds the arm. Then very gradually the elbow is flexed until approximately a right angle is obtained. The surgeon continues to hold the arm, and a posterior plaster-of-Paris splint is applied and the arm is put into a sling. The child may then be allowed out of bed, and, as soon as he can walk steadily, he may return to his home.

12. Removal of splint and taking of further roentgenograms. In three or four weeks' time, the splint is removed and the elbow x-rayed, to

see if sufficient union has taken place to allow removal of the plaster splint. The arm is then tied to the neck with a collar and cuff.

13. Institution of movement, at first by lowering and raising the forearm by the collar and cuff, and later by allowing freedom of movement. It is not only unnecessary but also unwise to stimulate or to enforce straightening of the elbow. It is advisable to encourage the use of the arm by normal movements.

An elbow with full function without deformity should be the result in approximately three or four months. This method of procedure must not be confused with the other methods in vogue for the care of supracondylar fractures.

Figures 9-A through 9-G are of particular interest, as this was the first case treated by the rapid method just described. A diagnosis of transcondylar fracture was made, and the lateral-traction type of reduction was immediately begun. The roentgenograms show how perfectly the reduction was accomplished.

#### GENERAL SUGGESTIONS

Do not be rushed into attempting an immediate manual reduction and fixation in the Jones position, if the roentgenograms show the characteristics of this type of fracture.

Do not be influenced by the parents' desire to take the child home immediately after reduction.

Do not let the additional cost of hospitalization and frequent roentgenographic examinations influence you in your choice of method. In the end, the additional hospital expense is trivial in comparison to a deformed elbow joint for life.

Do not put the child in a private room with special nurses, as he will be much happier in a ward and the expense will be much less.

Do not be hurried in the removal of the traction in order to get the child out of the hospital.

Study your films carefully and look for the diagnostic points.

# METASTASIS TO BONE FROM CARCINOMA OF THE GASTRO-INTESTINAL TRACT \*

BY RALPH K. GHORMLEY, M.D., AND

JORGE E. VALLS, M.D., ROCHESTER, MINNESOTA

*Fellow in Orthopaedic Surgery, The Mayo Foundation*

*From the Section on Orthopaedic Surgery, The Mayo Clinic*

There has long been a general impression that carcinomatous lesions of the gastro-intestinal tract seldom or never metastasize to bone. Although these metastatic growths are rarely noted, the fact that they do occur must be recognized, and one who is interested in differential diagnosis of lesions of bone must remember this possibility in looking for the primary carcinoma when osseous metastasis is suspected.

From time to time reports on metastasis to bone from carcinoma of the gastro-intestinal tract have appeared in the literature. Since we had some difficulty in assembling these reports, we are summarizing them here. One of the most statistically accurate of these reports is that of Müller, who studied the records of 12,730 post-mortem examinations performed at the Basle Pathological Institute from 1817 to 1905. Some of his findings are given in Table I. Since Müller's percentages were

TABLE I

INCIDENCE OF METASTASIS TO BONE FROM CARCINOMA OF THE GASTRO-INTESTINAL TRACT (MÜLLER'S SERIES)

Situation of Primary Carcinoma	No. of Cases	Cases with Metastasis to Bone	
		No.	Per Cent.
Stomach.....	309	8	2.58
Oesophagus.....	101	7	6.93
Rectum.....	57	6	10.52
Gall bladder.....	56	2	3.57
Pancreas.....	19	4	21.05
Liver.....	15	3	20.00
Pharynx.....	10	2	20.00

based on post-mortem findings, it may be assumed that in his cases the disease was advanced. Sutherland, Decker, and Cilley found metastasis to bone in 1.9 per cent. of their cases of carcinoma of the stomach. They also reported metastasis to bone in fifteen cases of carcinoma of the colon; but they did not give percentages in this group. Geschickter and Cope-

\* Submitted for publication, July 30, 1938.

land found metastasis to bone in seven (1.3 per cent.) of 537 cases of carcinoma of the stomach and in three (0.6 per cent.) of 497 cases of carcinoma of the colon and rectum. Lawton reported that from January 1920 to December 31, 1935, 606 of the patients admitted to the Presbyterian Hospital, Chicago, received a diagnosis of carcinoma of the stomach. Ten of them gave symptoms which might be attributable to metastasis to bone, but the roentgenograms did not give evidence of skeletal lesions. Necropsy performed on seven of these ten patients disclosed metastasis to bone in three.

Kerr and Berger reported five cases of carcinoma of the stomach with metastasis to bone. They also found in the literature reports of 143 similar cases. Schinz (quoted by Stiasny) stated that in 1 per cent. of his cases of carcinoma of the stomach, metastasis to bone took place. Aufses reported eight cases of carcinoma of the rectum with metastasis to bone, in five of which the presence of the carcinoma was proved at necropsy. He stated that the metastasis is not brought about by embolic blocking of the blood vessels, but by "the periaxial stagnation of the neoplastic cells as they pass from the blood vessels outside of the bony structure into the vascular bed situated within the bone".

Jenkinson reviewed the literature on primary carcinoma of the gastro-intestinal tract accompanied by metastasis to bone and recorded forty-one cases, in which the sites of the primary growths were as follows: stomach, thirty-two cases; gall bladder, three; rectum, two; bile ducts, one; appendix, one; pancreas, one; and colon, one. In four of these cases, pathological fracture occurred; in twenty-five, there was metastasis to the vertebrae.

Warren, reporting on metastatic lesions in sixty-nine cases of carcinoma of the stomach, found four in which metastasis to bone had taken place. He noted that metastasis to bone in these cases was probably of more frequent occurrence than was usually appreciated. In all of his cases the growths were of the osteoclastic type. There were no pulmonary metastatic growths, and he thought that the tumor embolus in the blood stream must have passed through the pulmonary capillaries without lodgment. The same author, studying metastasis in 156 cases of carcinoma of the large intestine, found only two in which there was metastasis to bone. In both of these cases the primary growths were carcinomata of the rectum,—one an adenocarcinoma and the other a colloid carcinoma. Fort, on the other hand, expressed the belief that metastasis to bone from carcinoma of the colon is fairly common. In his series of cases there was metastasis to bone in five cases (2 per cent.) of colonic carcinoma; in two cases (1 per cent.) of gastric carcinoma and in one case (percentage not given) of oesophageal carcinoma.

The rather wide variation in the reported incidence of this type of metastasis is susceptible of explanation. In many cases, although metastasis to bone may be suspected when the diagnosis of the primary lesion is made, or subsequently, its presence is not established by exploration or

TABLE II

AGES \* OF FORTY-THREE PATIENTS (TWENTY-NINE MALES AND FOURTEEN FEMALES)  
WITH METASTASIS TO BONE FROM CARCINOMA OF THE GASTRO-INTESTINAL TRACT

Decade of Life	No. of Cases
21 to 30.....	2
31 to 40.....	5
41 to 50.....	10
51 to 60.....	13
61 to 70.....	11
71 to 80.....	2

\* Youngest, twenty-six years; oldest, seventy-five years.

roentgenographic examination, because the patient is recognized as one who is doomed to fairly early death from the primary disease, and to subject him to unnecessary procedures is not justifiable. Statistics compiled from results of post-mortem examinations, such as those of Müller, must be expected to give evidence of a relatively higher incidence of metastasis to bone than statistics such as we are about to report, which are based on diagnoses made when the patients were still living.

We have surveyed the records of cases in which a diagnosis of carcinoma of the gastro-intestinal tract was made at The Mayo Clinic in the fifteen years from 1922 to 1936 inclusive. The growths occurred in the oesophagus, the stomach, the duodenum, the jejunum, the colon, the sigmoid, the rectosigmoid, and the rectum. Cases in which tumors were primary in the liver, the pancreas, or other parenchymatous organs of the abdomen were not included in this series.

Our patients were divided according to the ages at which the metastasis was discovered (Table II). The majority of the patients were more than forty years of age, as would be expected. However, two patients were in the third decade of life and five were in the fourth. Therefore, metastasis to bone may take place at any age wherein carcinoma of the gastro-intestinal tract may occur.

The number of cases of metastasis to bone from carcinoma of the stomach or of the rectum was far greater than that in which metastasis was from any of the other organs listed in Table III. This seems significant until the relatively greater incidence of carcinoma of the stomach or of the rectum is brought to mind.

The estimated percentages of metastasis to bone from carcinoma of various parts of the gastro-intestinal tract are recorded in Table III. Apparently there is a larger percentage of metastasis to bone in cases of carcinoma of the rectum than in cases in which the primary growths are higher in the gastro-intestinal tract. However, the difference between the incidence of metastasis to bone from rectal carcinoma and that from

TABLE III

SITUATION OF FIFTY-ONE METASTATIC GROWTHS IN BONE ARISING FROM FORTY-THREE CARCINOMATA OF THE GASTRO-INTESTINAL TRACT, AND THE INCIDENCE OF METASTASIS TO BONE FROM SUCH CARCINOMATA

Primary Growths	Situation	No.	Secondary Growths					Incidence of Metastasis to Bone from All Carcinomata of the Indicated Organs* (Per Cent.)
			Spine	Pelvis	Ribs	Long bone	Sternum	
Oesophagus.....		1			1			0 2
Stomach.....		12	6	3	5	2	1	0 2
Small bowel.....		1	1					**
Colon.....		3	1	1	1			3
Sigmoid.....		3	2		2	1		0 3
Rectosigmoid.....		4	3	2				5
Rectum.....		19	6	8	1	3	1	0 5
Total.....		43	19	14	10	6	1	51

\* Encountered at the Clinic in period 1922-1936.

\*\* One case of metastasis from carcinoma of the small bowel; this primary growth is rare.

carcinoma of other portions of the gastro-intestinal tract is not great enough to make the point one of diagnostic importance.

In Table III it is evident that most of the skeletal metastatic growths are in the bones of the trunk,—that is, in the vertebrae, the pelvis, and the ribs. In only six cases were the long bones involved. This would be expected, because skeletal metastatic growths from most types of carcinoma have a similar distribution. Whether some of the invasion of bones of the pelvis was the result of direct extension may be questioned. Such a condition is difficult to determine without post-mortem examination, and even then it may be hard to recognize. It is our impression that few, if any, of these skeletal metastatic lesions represented direct invasions of bone from the primary lesion.

Some of those who have written on this subject have referred to the metastatic lesions as "osteoclastic" or "osteoplastic". We have reviewed the roentgenograms with this classification in mind and have noted the following: osteoclastic lesions in thirty-two cases; osteoplastic lesions in five; mixed lesions—that is, both osteoplastic and osteoclastic—in two; characteristics not noted in three; and characteristics indeterminate in one. Osteoplastic metastatic lesions, which are believed to have arisen from the gastro-intestinal tract, may actually have had origin in the prostate gland, and this organ must be ruled out as the possible situa-

tion of the primary lesion. In cases of advanced carcinoma of the rectum, this may be difficult without post-mortem examination.

#### SUMMARY AND CONCLUSIONS

In presenting this group of cases, we have attempted to emphasize the following points:

1. Carcinomatous lesions of the gastro-intestinal tract may metastasize to the skeleton.
2. Such metastatic growths will be discovered less frequently in clinical than in post-mortem examination.
3. The bones of the trunk are more frequently the sites of such metastatic lesions than are other bones.
4. On the basis of our study, we would place the incidence of metastasis to bone at from 0.2 to 0.5 per cent. of all cases of carcinoma of the gastro-intestinal tract, with the highest incidence of such metastasis in cases of carcinoma of the rectum.

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# CONGENITAL CONVEX PES VALGUS

BY L. LAMY, PARIS, FRANCE

*Chirurgien Orthopédiste de l'Hôpital Foch*

AND L. WEISSMAN, PARIS, FRANCE

*Assistant d'Orthopédie*

Although the appearance of this congenital deformity is distinctly characteristic, it has only recently been recognized as an entity. Consultation of the literature on this subject reveals a surprising number of different terms by which this condition has been successively designated: "*pied plat congénital*" (Nové-Josserand); "*pied plat valgus congénital*" (Camera); "*pied plat réfléchi*" (Galeazzi); "*luxation congénitale de l'astragale*" (Haglund, Deutschländer, Seiffert); "*luxatio et dystropia pedis sub talo*" (Sieg mund); "*pied valgus congénital convexe*" (Lamy); "*pied plat congénital par subluxation sous-astragalienne congénitale et orientation verticale de l'astragale*" (Rocher and Pouyanne); "*pes curvus congenitus*" or "*Kyrtopodie*" (Chrysopathes).

This list illustrates the wide divergence of views in the interpretation of this deformity, ranging from its non-recognition as a morbid entity (Ombrédanne) to its conception as a specific congenital malformation (Chrysopathes). Nevertheless, the particular characteristics of this deformity have been emphasized by all the authors. Clinically, these are: convexity of the sole, deviation into valgus of the posterior part of the foot, and abduction of the forefoot. The distinguishing roentgenographic feature is the vertical or oblique position of the astragalus (Figs. 1 and 2).

Based on the morphological characteristics of the deformity, one of us has proposed the term "*congenital convex pes valgus*". This permits a definite designation of the affection, and at the same time does not suggest the pathology, which might lead to a discussion.

## HISTORY

The first complete clinical, roentgenographic, anatomical, and pathological study was published in 1914 by Mlle. Henken, a pupil of Nové-Josserand's. Since that time, many authors have described the deformity and have given different points of view in regard to its etiology and pathology. The large number of observations which have been published (over 100) prove that the malformation is far from being rare, but the dates of these published articles show that the special interest in this deformity is comparatively recent,—mainly since "*roentgenography has enlarged the horizon of the study of flat-foot*" (Nové-Josserand).

## CLINICAL AND ROENTGENOGRAPHIC ASPECTS

The most striking feature which is observed when the medial aspect of the foot is examined is the disappearance of the ordinary concavity of

the sole (Fig. 1). It is, on the contrary, convex, and the summit of the convexity corresponds to the mediotarsal articulation. It is the dorsum of the foot which is concave, and the skin which covers this surface often presents a number of very small folds. This true inversion of the arch (to which both the equinus of the os calcis and the dorsiflexion of the forefoot contribute a part) constitutes the predominating symptom of the affection, judging from the terms which have been used to designate this condition: "*pied en piolet*" (Rocher); "*pied en bascule*" (Mau); "*pied en tampon de buvard*" (Gocht).

The foot appears elongated, and its medial border presents a very marked projection, which is made by the prominence of the astragalus and the navicular. The forefoot is drawn upward and outward, and there exists a sulcus in front of the lateral malleolus, above which are situated the tendons of the extensors. This hollow is due to the absence of the head of the astragalus, which is pushed back, so that it rests on its

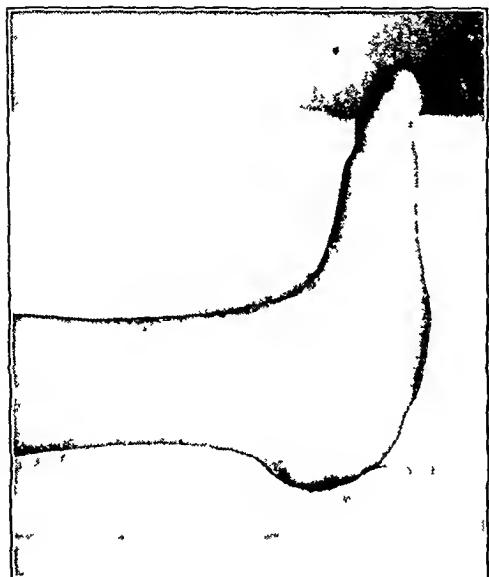


FIG. 1

Congenital convex pes valgus in a patient, aged five. Lateral view.



FIG. 2

Roentgenogram of same foot as in Fig. 1, showing the astragalus in the vertical position.

medial border. The posterior portion of the foot is in marked valgus. When the foot is in motion, the permanence of this malposition is easily seen. The contracted extensor tendons can be felt; they are prominent and resist all correction. This irreducibility, as well as the absence of nearly all movement, is usually the rule in somewhat advanced cases. However, in very young patients, or in less pronounced cases, it is often observed that if plantar flexion is impossible, extension or even dorsal hyperextension persists, permitting the foot to come in contact with the anterior surface of the leg (Nové-Josserand). According to Küstner, it is a question of the persistence of the primitive position of the foot in calcaneus. Other authors, such as Krukenberg, go even further and believe that, if this congenital pes valgus is so often unrecognized in the first months of life, it is because this calcaneus position of the foot masks other malpositions (valgus and convexity of the sole), and it is only later, when the calcaneus diminishes, that the exact nature of this deformity becomes evident. However, it is necessary to understand that the dorsiflexion of the forefoot, which we have just described, may give the impression of a foot in calcaneus, and this is an error which should be avoided.

The roentgenograms also present a characteristic appearance. The lateral view (Fig. 2) shows that the astragalus is vertical; its anteroposterior axis is more or less elongated in the line of the leg, making with the tibia an angle of about 180 degrees. The tibia appears to articulate only with the posterior part of the trochlea of the astragalus, and the anterior extremity of the astragalus is partially hidden behind the anterior extremity of the os calcis and the posterior portion of the cuboid.

The os calcis itself is tilted and the wide angle in front, which it made with the ground, has disappeared and is replaced by a wide angle behind, due to this tilting in front of and below its anterior prominence. In certain cases this appears to be somewhat atrophied, as if its development had been interfered with by the presence of the head of the astragalus (Nové-Josserand). The cuboid and navicular are in dorsiflexion, with a tendency to subluxation above. The navicular has lost all contact with the anterior portion of the head of the astragalus and articulates only with the superior portion of the neck of the astragalus. The

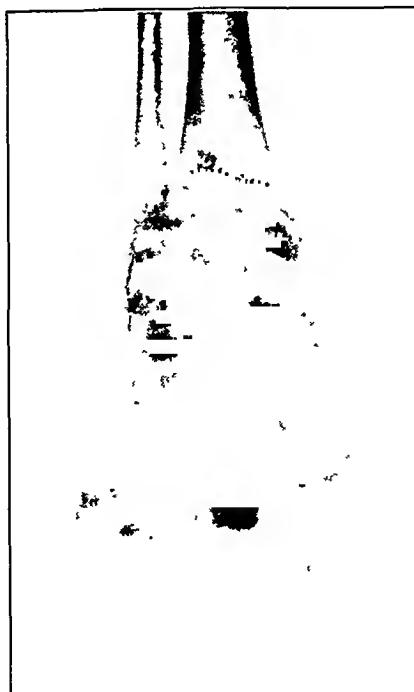


FIG. 3

Posterior view of the foot shown in Fig. 2, after operation. The graft anterior to the fibula is clearly visible.

cuboid itself is no longer in its usual position directly in line with the anterior portion of the os calcis. The metatarsals overlap each other, and do not make a single dark line in the roentgenogram. The anteroposterior roentgenogram shows deviation of the astragalus inward, with subluxation of the navicular and the cuboid outward.

It is not the pain which interferes with the function of the foot, but the difficulty in walking which is occasioned by the prominence on the under surface, so that the patient walks as if on the convexity of a stump. In the child, the retardation of the gait is often quite marked; the gait is heavy and awkward, and the equilibrium is very unstable. Contrary to that which happens in talipes equinovarus, and which becomes more pronounced during the growth of a child until adolescence, in this condition no great change either in form or in function is noted during this period of growth.

In addition to the type of deformity described, which is indisputably serious, there exist a number of less noticeable forms in which, since the astragalus is merely in a more or less marked oblique position, the appearance is that of a flattened or slightly convex sole. The anatomical disturbances are much less accentuated, and the malposition is not nearly so irreducible.

#### DIAGNOSIS

The convexity of the sole, the prominence on the inside of the astragalonavicular articulation, the abduction of the forefoot, the valgus position of the posterior part of the foot, and the almost complete irreducibility of the malposition are the clinical characteristics of this congenital convex pes valgus. To these may be added the following roentgenographic characteristics: the vertical or the marked oblique position of the astragalus, the tipping downward and forward of the os calcis, and the vertical subluxation of the navicular and the cuboid. The aggregate of these peculiarities allows a differentiation between this convex pes valgus and all of the other forms of pes valgus, whether they are congenital or acquired.

In the congenital forms, the absence of the fibula and Volkmann's deformity of the instep present a deviation of the foot toward the valgus position, sometimes very marked, in relation to the leg. The sole, however, is not at all convex, and the roentgenogram dispels all doubt by demonstrating that the lesion is situated at the level of the bones of the leg and that consequently the position of the foot is only a secondary deformity. This is also true of the flat feet which are due to abnormal ankylosis of the bones of the tarsus.

As to the acquired flat foot, either rachitic or adolescent, even when the valgus position is very marked, the arch is very flat, but it is never convex. When it is a question of a valgus foot, of a flat valgus foot, of a broad foot, or of a broad flat valgus foot—as these are differentiated in the recent classifications of the German observers—the characteristics are very different from those of the convex pes valgus. In the flat pes valgus the bones of the tarsus are lowered, but they preserve their normal relations: the navicular articulates with the anterior part of the head of the

astragalus; the cuboid, the lower portion of which projects between the os calcis and the fifth metatarsal, appears in place although a little lowered. As for the rest, the lowering is general. The axis of the os calcis, which normally forms with the ground a wide angle of 40 degrees in front, approaches the horizontal and does not make with the ground an angle of more than 5 or 6 degrees. The astragalus is also lower than normal, and carries with it the navicular, the cuneiforms, and the first metatarsal. However, its anteroposterior axis remains horizontal, and the variations from the right angle which it forms normally with the tibia are only slightly noticeable. There should be no difficulty in detecting these differences.

#### PATHOLOGICAL ANATOMY

All surgeons who have had the opportunity of operating on these convex valgus feet have observed that the position of the bones of the foot confirms the clinical and roentgenographic evidence. Through a dorsal external incision there is seen a hollow in which the astragalus is lacking (Lamy), but which contains a muscular mass formed by the extensor brevis digitorum and the extensor and peroneal tendons. In order to reach the head of the astragalus, an internal incision is necessary.

Anomalies of the form described by certain authors (Nové-Josserand, Krukenberg, Spiro, Deutschländer) are more difficult to deal with. These are as follows: the abnormal length of the neck of the astragalus and of the os calcis, the wedge-shaped deformity of the navicular, the incurvation of the neck of the os calcis above and the atrophy of its anterior prominence, as well as the atrophy of the head of the astragalus.

There is marked retraction of the tendons and ligaments, particularly of the extensor and peroneal tendons, as well as the tendo achillis. The fibular collateral ligament itself is very much retracted at the point which is exposed in the area of the incision (Lamy). The very marked thinning of the soft parts on the medial border of the foot, as described by Dengler, deserves attention. This author, in the course of many operations on the convex flat feet, partially excised these soft parts. Histological examination showed the existence of quite marked local arterial lesions of the chronic type of proliferating endarteritis (two cases). In two other cases, the lesions involved the nerve fibers, which were greatly thickened and presented the typical appearance of neurofibromatosis. According to this author, these lesions are evidence of a structural malformation associated with the malformation of the skeleton, and are found in nearly all cases of convex pes valgus.

#### ETIOLOGY AND PATHOLOGY

The extreme form of this congenital convex pes valgus is relatively rare, and it is more frequently seen in boys than in girls. According to the statistics of Sonnenburg and Eulenburg, among 688 cases of congenital club-foot, there were forty-two cases of flat-foot and fifteen in which the two malformations were associated. Küstner, in examining 300 feet of

newly born infants, found fifteen cases of flat-foot; the others were cases of club-foot. Timmer found congenital flat-foot in 10 per cent. of the newly born.

In comparison with the acquired type of flat-foot, the congenital form should be much more rare. Joachimsthal estimated it at 4.3 per cent. Preiser, out of 4805 flat feet examined, found only three which he considered to be of congenital origin. This difference in observation is explained by the fact that certain authors consider flat-foot in the newly born a normal condition, while others think that the flat sole is a pathological phenomenon. Thus, Henke, Hueter, Lorenz, and others believe that the foot is flat in all newly born infants, and Kirmisson considers that the arch is formed after birth under the influence of the contractions of the muscles, which become active at the time of walking. On the other hand, Spitzky, Dane, and later Böhm, through longitudinal section of the feet of the newly born, proved that a plantar arch exists at birth, but it is buried in the mass of fat tissue, which is very much developed in this region in the newly born.

It would appear, then, that congenital flat-foot can be regarded as an entity, and that from 2 to 3 per cent. of the newly born present an astragalus that is tipped, vertical, or merely oblique (Lamy). The true congenital convex pes valgus is much more rare.

Heredity may be an influence; the mother of one of our patients presents the same extremely marked deformity. Likewise, Aschner and Engelmann have observed convex pes valgus in a father and son. This deformity has also been found in two brothers (Sigal) and in identical twins (Armknecht).

The coexistence of other congenital malformations is very frequent. Those which are most often described are: congenital dislocation of the hip, club-foot, fusion of the vertebrae, congenital absence of the patella, congenital ankylosis of the joints, kyphosis, spina bifida, hernia, hypopspadia, microcephalia, Mongolian idiocy, and retardation of intellectual development.

As in all congenital malformations, rickets, tuberculosis, syphilis, or alcoholism of the parents have been suggested in turn, but their influence has never been proved. In our observations these factors have never been conspicuous. As is the case with the etiology, the pathology of the convex pes valgus remains more or less obscure.

As regards the pathology, there are two opposing opinions: the exogenous and the endogenous theories. In the opinion of the advocates of the first (Henke, Küstner, Joachimsthal, Lange, Krukenberg, Mlle. Henken), the malformation is occasioned by intra-uterine compression, due to the lack of space. Thus, the position of the foetus in the uterus, with extension of the leg on the thigh, would permit intra-uterine pressure on the feet, forcing them into this valgus position, which becomes permanent as the result of tendon retractions. It is also through lack of space that exochorial pregnancies occur (Kiewe).

Murk Jansen considered the congenital malformations to be of amniotic origin. He believed that the pathogenesis of flat-foot and club-foot could be traced to scantiness of the amnion, especially in the sixth week of intra-uterine life. It is, in fact, between the ninth and sixteenth weeks that the feet are developed, and a lack of amniotic fluid could gravely compromise their evolution.

Chrysopathes, while admitting that it is a question of a special malformation ("pes curvus") endeavors to explain it as being due to marked pressure of the tibia on the bones of the tarsus at a period in the very early embryonic development when the foot is in permanent dorsiflexion. When this is less marked, it leads to the ordinary type of flat-foot; when it is very marked, it results in a convex foot.

While these hypotheses may apply to certain cases, they cannot be applied to all. Although they recognize that in certain cases crowding of the foetus in an old or fibrous uterus may be an etiological factor, a number of authors (Rocher, Asch, Massé, Aschner, Legal, Seiffert, Engelmann, Böhm, Deutschländer, Spiro, Dengler, and others) have become partisans of the endogenous origin of the malformation. In favor of this point of view, there is, first of all, the coexistence so frequently noted of other congenital malformations, as well as the cases of familial or hereditary taint. Moreover, there is an anatomical, pathological, and roentgenographic resemblance between the congenital convex pes valgus and certain conditions of the foot in the course of its embryonic development.

The work of Böhm has shown that in the course of embryonic evolution of the lower limbs there are constant modifications in the form and position of the bones of the foot in relation to the leg. Thus, at the second month of intra-uterine life, the axis of the foot is in continuation with that of the leg. At the end of the second month and in the early part of the third, in addition to the beginning differentiation of the toes and the persistence of the equinus of the foot, there is observed a supination of the foot in relation to the leg. The os calcis is found under the astragalus, both being vertical. In the following stage, the adduction and supination of the foot increase and the equinus diminishes. At the end of the third month, the equinus is only very slight, and the foot then comes into the position of pronation in relation to the leg. The position of the bones of the feet which would correspond the best to that of the convex pes valgus is found at about the end of the second or the beginning of the third month of intra-uterine life (when the astragalus is vertical).

The malformation would indicate an arrest at this stage of the normal development of the tarsus (Böhm, Spiro), the abnormal persistence of the foetal state. However, the cause of this arrest is not known. Certain authors, Mau in particular, think that the arrest of development is due primarily to a spinal-cord lesion, and that deformity of the foot is only secondary. Beck, Largot-Roederer, Hackenbroch, Peltesohn, and Spiro assign a rôle to the action of spina bifida occulta, provided, however, that they have found clinical signs of ascending or descending degeneration of

the spinal cord (Ribbert, Marschand). Fuchs believed that there were less important, even microscopic, lesions of the cord, "*myélodysplasies*", which would explain the existence of these milder forms, but the actual existence of these lesions has not been demonstrated, in spite of the most careful investigations which have been made on this subject (Hackenbroch).

Franke has traced the origin of congenital flat-foot to a disturbance in the muscle equilibrium. He found in the course of an operation that the tendon of the tibialis anterior was not inserted on the plantar aspect of the first metatarsal and the first cuneiform, but on the dorsal surface; thus, the normal supinating action of this muscle was destroyed. Braus showed that in 50 per cent. of the cases the tibialis anterior did not have a supinating action, and that this was evidently due to the variation in its point of insertion.

Pursuing the same line of thought, Mau assumed a hypothesis according to which there would be a predominance of the action of the peronei in the course of the fourth stage of embryonic development, which would cause a deviation of the foot into the valgus position instead of the normal position of supination. This disturbance of muscle equilibrium, favoring the action of the peronei, would be due, according to him, to a lesion of the cord.

Hackenbroch and Hagenbach-Burckhardt attribute the cause of convex pes valgus to an abnormal congenital laxity of the muscular and ligamentous structures. Others believe in the theory of an arrest in the development of the bones of the foot, and consider the congenital pes valgus as an atavism.

As can be seen, all of these explanations are far from being satisfactory and the cause is still to be found. However, it appears that it should be sought among the endogenous factors, since the external factors intervene only occasionally. The rôle of the nervous system appears to be the most important, as it frequently gives evidence of other malformations and intellectual deficiencies, sometimes very marked. This is, moreover, our personal opinion of the pathogenesis of club-foot in general.

#### TREATMENT

The congenital convex pes valgus is made up of a series of tarsal subluxations and of musculotendinous and ligamentous retractions, and the treatment should vary with the degree and the multiplicity of the lesions and in accordance with the more or less considerable fixation of the deformity. It depends also on the age of the patient. The treatment should be early; the functional prognosis depends on this, and all authors are in accord with this statement.

When the patient is very young and the deformity is not marked, correction, either manual or with the aid of a redressement apparatus, should be attempted. Holmann corrects this deformity with the Alsberg apparatus, which permits very accurate localization of the forces to be employed. He first forces the head of the astragalus up and outward,

which brings the forefoot into plantar flexion. More pressure will then reduce the abduction of the forefoot. The position of the os calcis is then corrected. The lengthening of the tendo achillis is indispensable; otherwise, the replacement of the os calcis is impossible. It is sometimes necessary to cut the posterior ligaments of the tibiotarsal joint, and plaster should be put on in the best position. At the end of fifteen days, the correction should be repeated under the same conditions. The plaster bandages are renewed frequently, and each time a manual remolding aids in perfecting the end result.

Spitz and Krukenberg recommend the commencement of the correction in the first weeks of life, certainly before the tenth month. Spitz maintains the correction with the aid of a Chinese bandage, which consists of flannel bands, soaked in a glue solution, and wound around the foot from front to back, passing over the toes flexed to the maximum. He corrects each element of the deformity separately, and obtains adduction of the forefoot, supination of the heel, and plantar flexion. He treats the foot in this way until the end of the first year. In cases where there is a very marked resistance of the peronei and the extensors, he practises freezing of the peroneal nerve.

Rocher obtains correction by using the block of Lorenz, protected by a towel. First of all he corrects the malposition of the os calcis, which carries into calcaneus the posterior tarsus; then he flexes the anterior tarsus on the posterior tarsus, in order to correct the deformity of the sole by putting the foot into cavus with a certain degree of metatarsus varus (in an attitude of hypercorrection). The replacement is completed by a high tenotomy of the tendo achillis, which is done either at the same time or later. The end results are decidedly satisfactory.

It is evident that these attempts at correction apply only to the milder cases in which the astragalus is merely oblique and the sole of the foot is flat or only slightly convex. When the deformity is somewhat marked and, therefore, difficult to reduce, it will yield only to surgical interference.

By far the most serious factor in the deformity is the tipping of the astragalus, and this should always be considered. The authors who have had experience with this condition have nearly all recognized the necessity of extirpating the astragalus. Deutschländer's case is illustrative of this point of view. In treating a case of congenital pes valgus in a child



FIG. 4  
End result.

of six years, this author reestablished the contact between the head of the astragalus and the navicular, and corrected the equinus by a bony bridge clearly visible in the roentgenogram. There was a complete relapse at the end of six months, and the correction was not permanent until after a resection of the head of the astragalus had been performed.

At the Congress of the French Orthopaedic Society, in October 1928, Allenbach emphasized the necessity of reshaping or extirpating the head of the astragalus, which, being wedged between the os calcis and the navicular, is an obstacle to correction.

Since operation on the tendons—section of the tendo achillis, of the peronei, of the fibular collateral ligament, and of the posterior ligaments—has no influence on the convexity of the sole, Camera advocated curetting of the astragalus and resection of the cuneiform portion of the navicular. Nové-Josserand practised the same method, but, instead

of curetting the astragalus, he resected its head and neck, which permitted the reestablishment of the arch of the foot. Baumann combined tendon transplants with this operation.

Rocher insisted upon three stages as essential: (1) through a dorsal incision, external section of the retracted fascial ligaments (the anterior talofibular ligament and the calcaneofibular ligament) and lengthening of the lateral peronei, either by bifurcation or by section at different levels; (2) high subcutaneous section of the tendo achillis, which allows the foot to be put into calcaneus; (3) internal incision along the astragalonavicular ar-



FIG. 5

Shoes worn before operation.



FIG. 6

Shoes worn after operation.

ticulation and exposure of the head of the astragalus. The latter is grasped and forced into its normal position by pushing it from above and outside and carrying the forefoot into varus. The foot is then placed in a position of correction,—that is, the forefoot in cavus varus and the posterior part of the foot in calcaneus. Rocher also emphasizes the necessity of prolonged postoperative treatment.

As for us, our preference is for astragalectomy. Having since 1910 objected to astragalectomy in other cases because it left a pes cavus, one of us very naturally was tempted to perform an astragalectomy to correct a convex foot. We have done a total or partial astragalectomy, according to the extent of the lesion. In most cases, we have removed that part of the astragalus which is above the tibia, leaving only the posterior part of the trochlea, which is intended to articulate in the mortise. The section of the fibular collateral ligament allows the portion of the astragalus to be easily forced in under the tibial articulation.

Judging from our experience, it seems to us indispensable to cut the fibular collateral ligament, which allows the reduction of the valgus. Both the external and the internal approaches are necessary. The first permits not only the section of the fibular collateral ligament, but also the lengthening of the extensor tendons and the peronei; the second allows the partial resection of the astragalus and also the temporary detachment of the tibialis anterior and its reinsertion under tension on the first metatarsal. It seems to us that in the feet so treated there is more recovery of mobility than in the others.

Early in our experience, one of us, in operating by the usual approach, was impressed by the dimensions of the sulcus found in front of the lateral malleolus, and thought of filling this with the portions of the astragalus which had been removed. This graft proved to be extremely good and gave excellent results. It helped to restore a more normal form to the ankle, and seemed to support the foot on the leg and to prevent the return of the valgus. Figure 3, the postoperative roentgenogram of the foot shown in Figure 2, reveals a dark area at the level of the articular surface of the astragalus, which is nothing but the fragments of the excised portion of the astragalus which were fixed in this position.

After the operation, the foot is immobilized in a position of mild varus for two months. At the end of this time, the patient is allowed to walk with a light brace, which permits free ankle motion, and which is designed to allow walking and at the same time to maintain the position,—that of slight varus and arching of the sole. In the young child, walking serves to remodel the foot and is a matter of capital importance. This is also true in respect to all the deformities of the feet in children.

The results obtained by this method are very encouraging. The form of the foot is changed (Fig. 4) and definitely resembles that of the normal foot. The function is entirely improved: the child can walk, run, maintain his equilibrium, and carry on a normal life. The aesthetic improvement is most satisfactory, as can be seen by comparing Figures 5

and 6. The former shows the grotesque shoes which the child wore before operation; the latter, the normal shoes worn after operation.

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## THE HOKE OPERATION FOR FLAT FEET \*

BY JOSEPH B. L'EPISCOPO, M.D., F.A.C.S., AND PETER E. SABATELLE, M.D.,  
BROOKLYN, NEW YORK

*From the Orthopaedic Department of Kings County Hospital, Brooklyn*

In October 1931, Dr. Michael Hoke<sup>1</sup> published the results of an operation for flat feet. Not many orthopaedic surgeons, aside from Dr. Hoke, have reported on the use of this operation. We are, therefore, presenting an analysis of the end results obtained in sixteen cases in which this operation was performed at the Kings County Hospital between 1933 and 1937. We are not recording a seventeenth case of this series, as follow-up study was not available. The operation which we have performed is essentially that devised by Dr. Hoke, except that we have attempted to fuse only the first cuneiform and the navicular.

### INDICATIONS

We have performed the operation mainly on older children whose average age was thirteen years, although our youngest patient was seven years old and the oldest was nineteen years of age. We operated only on patients who suffered from flaccid flat feet, associated with pain or fatigue or both, and whose symptoms were of a static nature. We tried to be sure that there were no arthritic symptoms.

Of the sixteen patients operated upon, fourteen complained of both pain and fatigue; one of pain alone; and one, of fatigue alone. In addition to having clinical evidence of flat feet, these children all showed a convexity of the long arch downward, as demonstrated in the roentgenograms taken in the lateral view, with weight-bearing.

In each of these sixteen cases, both feet were operated upon, making a total of thirty-two feet. In fourteen cases, the first cuneiform and the navicular were bridged by small bone grafts. In one case, bone chips were placed between these two bones; and in one case, a wedge was removed between these two bones, and the raw surfaces were brought together. The tendo achillis was lengthened in fourteen cases. In the other two cases, the tendo achillis was not lengthened, as we felt that it was already long enough.

### POSTOPERATIVE TREATMENT

The patients were allowed to walk with casts and the aid of crutches three weeks after the operation. The feet were immobilized for a period of from five to twelve weeks, with an average period of nine weeks. This variation was due to the fact that some of the patients, when discharged from the Hospital, did not return to the Out-Patient Department at the

\* Read at the Orthopaedic Section of the New York Academy of Medicine, May 20, 1938.

TABLE I  
SUMMARY OF SIXTEEN CASES OF FLAT-FOOT IN WHICH THE HOKE OPERATION WAS PERFORMED

Patient	Age (Years)	Sex	Main Symptoms	Preoperative Arch Convexity	Postoperative Arch Convexity	Bony Union	Postoperative Symptoms	Postoperative Period	Results	Remarks
1. B. D.	18	Male	Pain and fatigue	Downward	Downward	Yes	Slight pain in left foot	3 years	Fair	
2. F. M.	13	Male	Pain and fatigue	Downward	Upward	No	None	1½ years	Good	
3. A. R.	16	Male	Pain and fatigue	Downward	Upward	Yes	None	1½ years	Good	Tendo achillis not lengthened.
4. E. B.	14	Male	Pain and fatigue	Downward	Upward	Right: Yes Left: No	None	17 months	Good	Bone chips used instead of graft.
5. J. S.	9½	Male	Pain and fatigue	Downward	Upward	Right: No Left: Yes	None	16 months	Good	Wedge removed. No graft used.
6. A. R.	13	Female	Pain and fatigue	Downward	Downward	No	Slight pain	2½ years	Fair	Tendo achillis not lengthened.
7. G. P.	13	Male	Pain	Downward	Upward	Right: Yes Left: No	Slight pain in left foot	15 months	Fair	
8. Z. F.	13	Male	Fatigue	Downward	Upward	Yes	None	2 years	Good	
9. F. R.	11	Female	Pain and fatigue	Downward	Right: Upward Left: Downward	Yes	None	2 years	Good	
10. J. M.	7	Male	Pain and fatigue	Downward	Right: Upward Left: Straight	Yes	None	10 months	Good	
11. F. P.	19	Female	Pain and fatigue	Downward	Downward	Yes	Slight pain in left foot	2 years	Fair	
12. R. K.	16	Female	Pain and fatigue	Downward	Upward	Right: No Left: Yes	None	19 months	Good	
13. V. S.	8	Female	Pain and fatigue	Downward	Right: Downward Left: Upward	Right: No Left: Yes	Slight pain in right foot	8 months	Fair	
14. F. P.	14	Female	Pain and fatigue	Downward	Upward	Yes	None	19 months	Good	
15. N. C.	11	Female	Pain and fatigue	Downward	Upward	Right: Yes Left: No	None	15 months	Good	
16. M. Y.	15	Female	Pain and fatigue	Downward	Upward	Yes	None	11 months	Good	

specified time. Whitman plates were applied when the casts were removed, and these were worn for a period of from two to twelve months, with an average period of eight and one-half months. Again the variation in time was due to the fact that the patients did not report to the clinic regularly. Many gave the excuse that as long as they felt well they did



FIG. 1-A



FIG. 1-B

Fig. 1-A: Case 16. M.Y. Preoperative anterior view, showing natural standing posture. The patient had severe pain and fatigue and pressure sores over the navicular prominence.

Fig. 1-B: Case 16. M. Y. Preoperative posterior view, showing natural standing posture.



FIG. 1-C



FIG. 1-D

Fig. 1-C: Case 16. M. Y. Anterior view, one year after operation. Pain and fatigue were relieved, and there were no pressure sores. Bony union was present at site of graft on both sides.

Fig. 1-D: Case 16. M. Y. Posterior view, one year after operation.

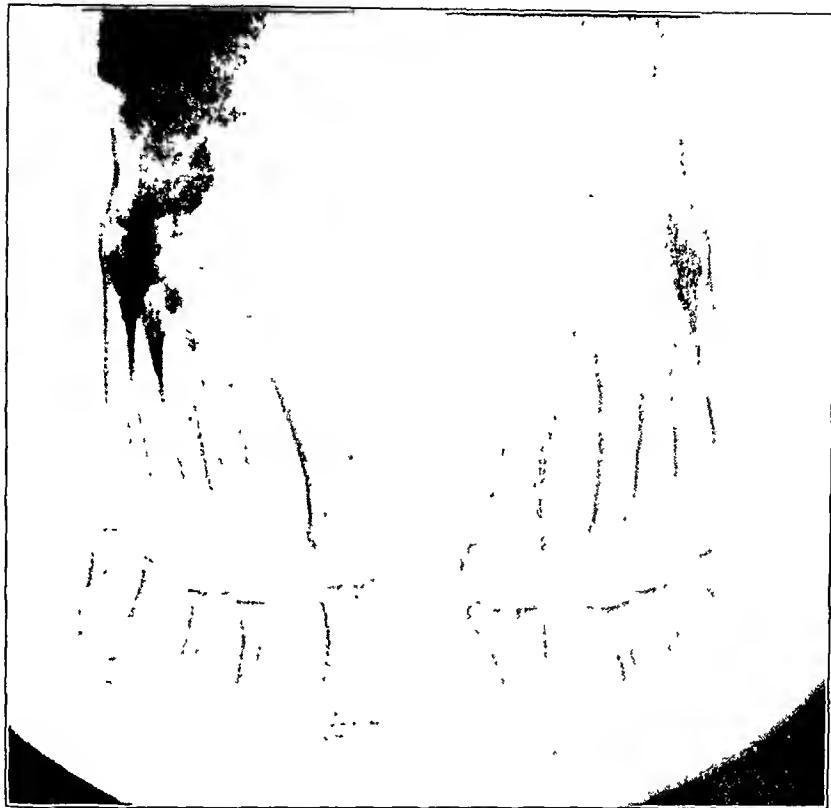


FIG. 2

Case 11. F. P. Anterior view, three months after operation, showing graft.

not think it important to return for observation. We believe that many of these patients wore the plates for a much longer period than necessary.

#### RESULTS

For the purposes of this report, we tried to obtain check-up examinations on all of these patients. As we have stated, we were able to do so in all but one of these patients. Therefore, this study will be based on these sixteen cases.

There were eight females and eight males, varying in age from seven to nineteen years. The observations are based on follow-up periods of from eight months to three years. The results are classified as *good*, if all symptoms were relieved; as *fair*, if symptoms were partially relieved; as *poor*, if symptoms persisted. The results are based on functional improvement only, and not on correction of the arch or fusion or non-fusion as seen in the roentgenogram.

The results were good in eleven cases (five females and six males), and fair in five cases (three females and two males). There were no poor results.

Roentgenographic examination showed bony union on both sides in

eight cases. In six of these, the results were classified as good and in two as fair. In two cases, union did not take place, and the results were classified as good in one and as fair in one. In six cases, union occurred in one foot and the results were classified as good in four and as fair in two.

In ten cases the arch was restored in both feet, irrespective of whether or not bony union had been obtained. Of these ten, the results were good in nine and fair in one. The latter patient had bony union on the right side and fibrous union on the left.

In three cases, the arch was restored in one foot. In two of these cases, the arch in one foot remained downward, and the results were classified as good in one and as fair in the other. In the other case, the arch in one foot was partially restored, and in this case the result was classified as good.

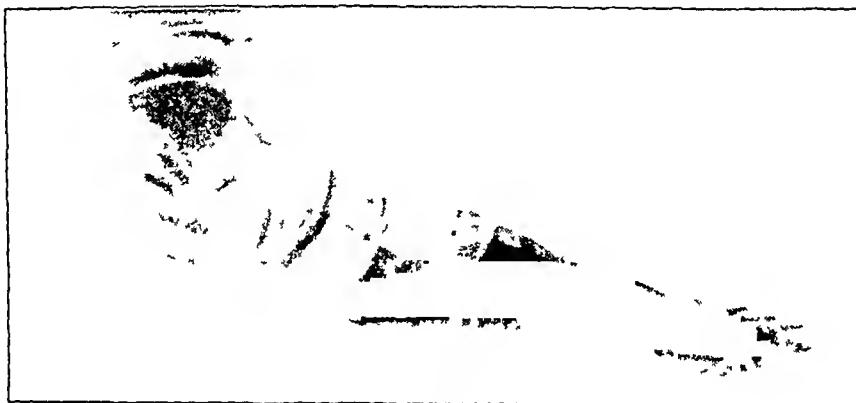


FIG. 3-A

Case 4. E. B. Lateral view of foot, taken with weight-bearing, showing preoperative posture

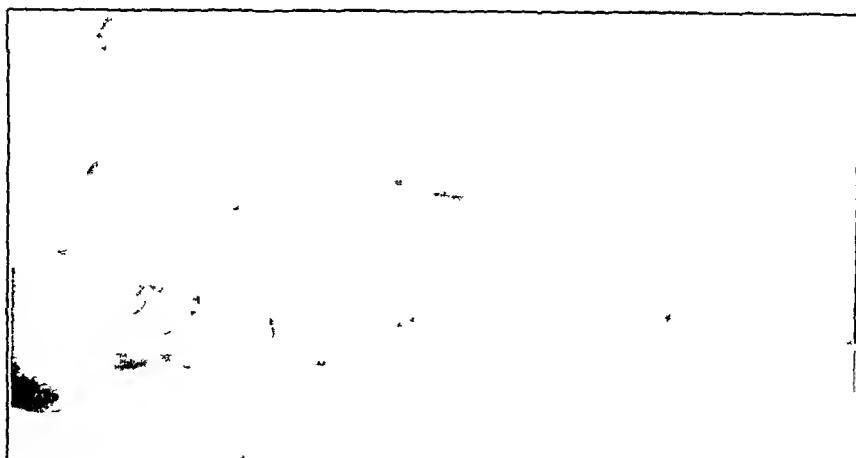


FIG.  
of foc

Case 4. E. B.  
postoperative post

In three cases the arches were not restored in either foot. In these three cases the results were classified as fair.

The relation of age to the final result may be of interest. The ages of those patients classified as having good results were: thirteen, sixteen, fourteen, nine and one-half, thirteen, eleven, seven, sixteen, fourteen, eleven, and fifteen, respectively. Of those classified as having fair results, the ages were: eighteen, thirteen, thirteen, nineteen, and eight, respectively.

There were four cases in which the operative technique varied from that of Hoke. In two cases, the tendo achillis was not lengthened; otherwise, the technique was the same. Of these, the result in one was classified as good, with fusion and restoration of the arch on both sides. In the other, the result was classified as fair, with no fusion on either side and the arches unchanged. In another case, a wedge of bone was removed between the navicular and the first cuneiform. This gave a good result, with union on one side and restoration of the arches. In another case, bone chips were used instead of a graft between the first cuneiform and the navicular. This also gave a good result, with restoration of both arches and union on one side. All patients with a fair result were relieved of symptoms to such an extent that they would accept the operation again if they had to repeat their experience. Every patient was asked this question specifically.

All these patients had received thorough conservative treatment, usually for a number of years, before being operated upon.

#### SUMMARY AND CONCLUSIONS

In the sixteen cases reported, the follow-up period varied from eight months to three years. The results were good in 68.7 per cent., and fair in 31.3 per cent. of the cases.

We feel that the operation is definitely indicated in a well-selected group of children with flaccid flat feet.

It seems that bony union is not essential for good results. Some patients were definitely relieved, in spite of a fibrous union.

1. HOKE, MICHAEL: An Operation for the Correction of Extremely Relaxed Flat Feet  
*J. Bone and Joint Surg., XIII, 773, Oct. 1931.*

## RECONSTRUCTION OF THUMB AFTER TRAUMATIC AMPUTATION

BY DONALD E. DIAL, M.D., CLEVELAND, OHIO

The amputation of a thumb, the most mobile and the most useful of the digits of the hand, leaves a working man with a terrific handicap. Any method which can improve the function of such a hand is of great value.

Several procedures have been designed for this purpose and have been summarized by Gueullette. The choice of a method in any case depends on the extent of damage, if any, to the rest of the hand and on the nature of the stump which remains. The simplest type of procedure has been called phalangealization of the metacarpal. It consists essentially of separation of the intrinsic muscles from the distal end of the first metacarpal, in order to eliminate enough of the web between the first two metacarpals, so that articles can be grasped between them. While this method permits grasping, it leaves a short thumb, the end of which cannot easily be opposed to the fingers.

Methods of overcoming this objection involve the transplantation,

by pedicled flaps, of skin and bone to lengthen the thumb. The most common procedure of this sort is the tubed pedicled flap from the abdomen, with a free graft from the tibia inserted into the tube either before or after it is sutured to the thumb. This type of operation is usually successful, especially if the proximal end of the first phalanx with its tendon attachments has been preserved. If this is not the case, the thumb which results is stiff and may be of little practical value.

For cases in which the amputation is

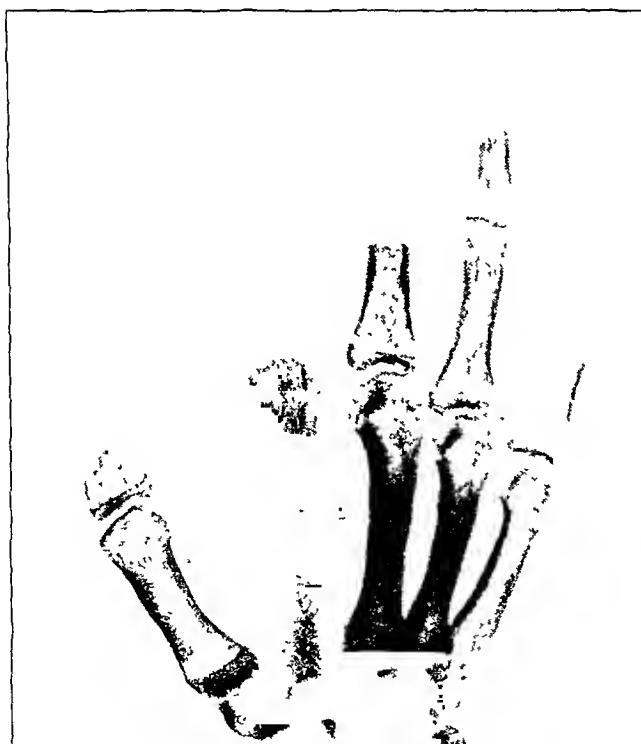


FIG. 1

Roentgenogram taken in August 1936, showing the original injury.



FIG. 2

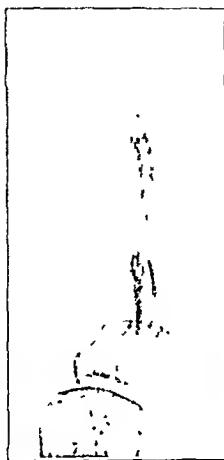


FIG. 3



FIG. 4

Fig. 2: December 11, 1936. Pedicled flap from left clavicle, with bone graft not yet united. The graft had been impacted, but did not remain in position.

Fig. 3: March 10, 1937. A second bone graft was taken from the stump of the middle finger on February 22. The distal tip of the first graft has nearly separated, and was later removed.

Fig. 4: March 7, 1938. The grafts are solidly healed. The marrow cavity in the grafted bone is barely visible. The bone has assumed a new shape, determined by functional stress.

through the metacarpophalangeal joint or proximal to it, attempts have been made to transplant an entire digit, either one of the toes (Kleinschmidt) or a finger from the injured or from the uninjured hand (Joyce). The authors of this type of operation hoped to obtain a thumb with functioning tendons and joints. Surgery of the hands is difficult enough to begin with, and, when thus complicated by transplantation of an entire digit, the procedure has usually given disappointing functional results.

In the following case, the treatment carried out by the author has resulted in a mobile thumb with a firm grasp.

The patient, a boy, eighteen years old, in August 1936, sustained a traumatic amputation of the right thumb about half an inch distal to the metacarpophalangeal joint. In addition, the index finger was amputated through the metacarpophalangeal joint and the middle finger through the middle of the proximal phalanx. The other two fingers were uninjured (Fig. 1). Since there was insufficient skin to cover the end of the second metacarpal, a tubed pedicled flap was transferred to the hand to fill the defect. The tube was made longer than necessary for this purpose, in order, by double transfer of the flap, to use the other end of the tube for lengthening the thumb. So much of the tube was lost, due to poor circulation, that this plan had to be abandoned.

The next attempt to lengthen the thumb consisted of the transplantation of a tube of skin from directly over the left clavicle, with a segment of the clavicle included. According to Guecullette, such an operation was described by Albee, but it was given up in favor of the abdominal flap with a bone graft from the tibia. It was hoped that the blood supply of the clavicular fragment could be kept intact and thus ensure a live bone graft. This was found to be technically a difficult matter, and, before the procedure ended, the bone was virtually a free graft in the center of the tubed skin. However, when the medial end of the tube was severed and sutured to the stump of the thumb on the twenty-fifth day after operation, the bone was found firmly attached to the soft

tissues, indicating that the bone was probably living. The end of the bone graft was impacted into the marrow cavity of the stump of the thumb, and the position of the hand was maintained by adhesive-tape dressings. In spite of the fact that the distal end of the flap was not severed until the twenty-third day, about half an inch was lost by gangrene. Passive vascular exercise was given for about three weeks, which probably prevented loss of a larger portion of the graft. Due to this difficulty, the bone graft did not unite (Fig. 2). After three months, a small longitudinal fragment of bone was removed from the stump of the middle finger (without sacrificing any of its length) and inserted into the defect after the bone surfaces had been freshened. Three months later, there was definite bony union of the grafts (Fig. 3). At the end of an additional six weeks, the patient was discharged without a splint. The metacarpophalangeal joint had fair mobility, and the patient was able to oppose the thumb to the remaining two fingers of

hand. A roentgenogram, taken a year after the last operation (Fig. 4), shows solid union of the grafted bone. Although the bone is smaller in diameter than that of the normal thumb, the proximal half of the graft has increased in size, a good demon-



FIG. 5

The end result, March 1938. The transplanted skin is deeply pigmented.



FIG. 6

The reconstructed thumb has a firm grip.

stration of the effect of functional stress on the structure of bone. It is also interesting to note the development of a definite marrow cavity in the proximal half of the grafted bone, which was originally composed of two separate fragments of cortical bone. The end result (Figs. 5 and 6), while far from perfect, is a mobile thumb, which is capable of a firm grasp. The patient's handicap has been considerably reduced by this addition to the length of the thumb.

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## ASEPTIC NECROSIS OF HEAD OF FEMUR FOLLOWING TRAUMATIC DISLOCATION \*

BY FRANK N. POTTS, M.D., AND BEN E. OBLETZ, M.D., BUFFALO, NEW YORK

*From the Department of Orthopaedic Surgery, University of Buffalo Medical School*

There has always been a group of bone changes which has invited some speculation as to causative factors. None of these have been more interesting than the changes involving the head of the femur. The recent studies of the blood supply about the hip joint and the observations by Phenister on the nature of aseptic necrosis of the head of the femur have helped in placing our knowledge on a more firm basis. During the past six years, it has been the writers' opportunity to deal with five cases of marked pathological changes in the head of the femur following simple traumatic dislocation, uncomplicated by fracture of any degree involving either the femoral head or the acetabular rim. It is thought that a review of these cases may be of interest.

All of these cases occurred in active, vigorous, healthy individuals between the ages of nineteen and thirty-four years. Four resulted from automobile injuries and one from a fall of twenty feet. Only one of the patients sustained the so-called "dashboard dislocation of the hip", described by Funsten, Kinser, and Frankel. The original clinical and roentgenographic examinations showed simple dislocation of the hip. Reduction of the dislocation was effected within a few hours, in the same day, or in a few days in four cases, but was delayed for fourteen days in one case. The post-reduction period of fixation varied from four days to three weeks. The patients were all discharged as cured without disability. Then followed a long period of well-being of from two to five years, after which the patients began to limp and to complain of pain and stiffness in the hips previously traumatized. The symptoms increased in severity until medical advice was sought.

Examination of all patients showed a limitation in flexion, abduction, and rotation in the affected hip. All motions were painful, especially at the limits of active mobility. In two cases there was shortening, and these patients thought that the shortening was increasing. All laboratory findings, except the roentgenograms, were negative. The salient features of these cases are recorded in Table I.

The clinical impression of osteo-arthritis of the hip in each of these five cases was confirmed at operation, when moderate to extensive changes were found in the articular cartilage of the head. Underlying the arthritic changes and causing them were changes in the subchondral bone as seen by the roentgenograms and on histological examination.

The roentgenograms revealed startling changes in the femoral heads.

\* Read at the Annual Meeting of the American Orthopaedic Association, Atlantic City, New Jersey, May 4, 1938.



FIG. 1-A

Case 1. T. G. June 10, 1933. The right hip is dislocated, but the density and outline of the head of the femur compare exactly with those of the normal.



FIG. 1-B

Case 1. T. G. June 10, 1933. After reduction. It is quite impossible to detect any difference in the two hips.



FIG. 1-C

Case 1. T. G. October 10, 1935. Close examination shows a slight flattening of the upper part of the femoral head and a slight increase in density in the region of the old epiphyseal line, as compared with the normal hip. There are no changes in the fovea centralis, nor is there any definite narrowing of the joint space.



FIG. 1-D

Case 1. T. G. August 10, 1937. Extensive destructive changes are seen in the femoral head. The head is flattened and subluxated. There are marked increased density and of osteoporosis and apparently a complete loss of the substance of the bone. The normal trabecular markings have disappeared.

These changes were not consistent in all five cases, but, in general, the roentgenograms showed an alteration in the contour of the head of the femur, narrowing of the joint space, and a change in the density of the epiphysis, characterized by mottled areas of increased density and by areas of osteoporosis. In all of the cases the normal trabecular arrangement was lost. These changes can best be seen in the roentgenograms of the individual cases, and are, therefore, described separately. They constitute the roentgenographic findings in aseptic necrosis.

In Case 4, a large portion of the head of the femur was resected during the reshaping necessary for an arthroplasty. Grossly, the head of the femur showed irregular roughened articular cartilage, which had lost its normal glistening surface. There were irregular exostoses at the margins of the cartilage. The head at the site of resection was very dense and gave considerable resistance to the osteotome. The bone marrow was red and oozing with blood, showing that at the site of resection the bone was living. Histological sections were studied. (See Figures 6 and 7.)

A review of the available literature reveals that only recently has this condition been recognized. Recent and old textbooks do not mention this complication of traumatic dislocation of the hip. The literature of the past ten years shows that observers in Europe as well as in America are recognizing and reporting this now well-established entity. A recent report by Funsten, Kinser, and Frankel revealed six instances of aseptic necrosis among twenty cases of traumatic dislocation of the hip.

It is our impression that the pathological changes in the head of the femur are the result of injury to the arterial blood supply to the epiphysis. There is no evidence in these cases that infection or constitutional disease plays any part in the production of this lesion. Wolcott has demonstrated that the major blood supply reaches the head of the femur by way of the ligamentum teres and the visceral capsular arteries. These vessels anastomose within the femoral head. In traumatic dislocation of the hip, it is evident that the ligamentum teres is ruptured, or at least severely stretched, and that the capsule may be torn. The vessels entering the head from the visceral capsular arteries may be ruptured, cutting off entirely the blood supply to the femoral head. This ischaemia may be complete or partial, and in either case it leads to an aseptic necrosis of the epiphysis. The normal weight-bearing properties of bone are lost when the head becomes necrotic, and, because of this lessened mechanical resistance, the head disintegrates. Minute fractures take place in the subchondral bone and the static arrangement of the trabeculae is disrupted. The subchondral bone loses its normal, smooth, rounded outline and fails to support the articular cartilage. This, together with the primary necrosis of the cartilage, results in a secondary degenerative osteo-arthritis, which gives rise to the clinical symptoms. The necrotic bone is slowly resorbed by a process of creeping substitution, as described by Phemister. In our cases we were unable to obtain late roentgenograms, and we are, therefore, unable to state how far this process of reorganization of the head has progressed.

With the knowledge of this lesion, we can no longer be safe in giving a good prognosis in a case of reduced traumatic dislocation of the hip. The significance of this delayed complication from a medico-legal standpoint is obvious.

Can certain measures be taken to avoid this complication? There is great opportunity for speculation here. Early and gentle reduction is desirable to prevent any increase in the damage already done to the blood supply. Prolonged immobilization may be of value to permit the blood vessels to establish themselves as quickly as possible. Roentgenograms should be taken every six months for from three to five years, so that early signs of aseptic necrosis may be detected before too much damage has been done to the head of the femur by weight-bearing. If the condition of aseptic necrosis is recognized early, before marked changes in the contour and consistency of the femoral head take place, reorganization of the affected bone may be accelerated by means of multiple drill channels through the neck and into the head, as suggested by Bozsan in the treatment of Legg-Perthes disease. Because the process of reorganization is such a slow one, it would be difficult to get cooperation from any patient if a period of recumbency of from two to three years is advised, so that the structurally weakened head will not be deformed by weight-bearing. Our



FIG. 2

Case 2. G. J. The irregular femoral head is diminished in size and is cone-shaped. At the superior trachelo-epiphyseal angle is a large cyst-like area of porosis, while the entire head and subjacent portion of the neck show irregular areas of porosis and sclerosis. The acetabulum appears normal.

TABLE I  
SUMMARY OF CLINICAL FINDINGS IN FIVE CASES OF ASEPTIC NECROSIS OF THE HEAD OF FEMUR FOLLOWING TRAUMATIC DISLOCATION

	Case 1—T. G.	Case 2—G. J.	Case 3—J. O.	Case 4—A. P.	Case 5—S. C.
Sex	Male	Male	Male	Female	Male
Age at injury	34 years	31 years	19 years	20 years	30 years
Hip	Right	Left	Left	Left	Left
Cause of dislocation	Automobile collision	Fall (20 feet)	Automobile collision	Automobile collision	Automobile collision
Interval before reduction	2 weeks	24 hours	Several days	4 days	12 hours
Immobilization after reduction	3 years	5 years	3 years	3 years	2 weeks
Free interval	2 weeks	2 weeks	3 years	Present	Present
Earliest symptoms:	Present	Present	Present	Present	Present
Limp	Present	Present	Present	Present	Present
Pain	Present	Present	Present	None	None
Stiffness	Marked	Marked	Marked	None	Marked
Examination:					
Restricted motion					
Spasm					
Shortening					
Contracture					
Atrophy					
Laboratory:					
Urine					
Blood glucose					
Urca nitrogen					
Calcium				Negative	Negative
Phosphorus				Negative	Arthroplasty
Bence-Jones protein				Negative	Arthroplasty
Wassermann reaction				Negative	Arthroplasty
Tuberculin test				Negative	Arthroplasty
Operation				Arthrodesis	Arthrodesis



FIG. 5

Case 5. S. C. The acetabulum is normal, but the joint space is narrowed. The weight-bearing portion of the head is flattened, and a subchondral fracture line extends into the epiphysis from the point where the head impinges against the acetabular rim laterally. There are irregular mottled areas of osteoporosis involving the head and the subcapital portion of the neck.



FIG. 4

Case 4. A. P. September 29, 1937. The joint space is narrowed. The normal contour of the head appears to be intact, but a subchondral fracture line extends from the lateral portion of the epiphysis at the point where it contacts the acetabular rim. A small exostosis is seen laterally. The weight-bearing portion of the head is of uniformly increased density and appears to be undergoing a dissecting process less extensive than that seen in Case 3. The pathological changes appear to be confined to the femoral head itself.



FIG. 3

Case 3. J. O. The joint space is narrowed beneath the acetabular rim. The surface outline of the femoral head is irregular, but the greatest change is in the density of the head. The proximal half of the head is of uniformly increased density, and is separated from the remainder of the femur by a definite irregular wide zone of diminished density. The impression is that of an osteochondritis disseccans, with a sequestration of the weight-bearing portion of the femoral head. Beneath the line of dissection are several areas of increased density. The neck and trochanter are not involved.



FIG. 6

Figs. 6 and 7: Case 4. A. P. Over one area the articular cartilage is necrotic and thin. Its free surface shows fraying. Beneath this area, the bone reveals distinct evidences of localized necrosis, absorption, and disappearance of trabeculae. Extreme fibrous metaplasia of the marrow has occurred. The fibrous marrow is rich in dilated capillaries. Plasma cells are scattered; hemosiderin granules are present. In the fibrous site are fragments and splinters of necrotic bone undergoing resorption of osteoclasts. There is also seen bone apposition upon necrotic fragments. Of greatest interest is the new formation of cartilage within the fibrous marrow. The process includes necrosis of bone, marrow, and cartilage, with bone resorption and fibrous metaplasia, as well as transformation of the bone and cartilage.

five patients were not seen early enough to permit these conservative methods of treatment.

Our operative choice rested between arthroplasty and arthrodesis. In two cases, where the degenerative process appeared to be in the early stages, arthroplasties were done; to date, the results are excellent in Case 4 and only fair in Case 5. In the other three cases, it was felt that the destruction of the femoral heads was too far advanced to warrant any



FIG 7

treatment other than arthrodesis. Two patients now have good, painless, weight-bearing hips, surgically ankylosed; the last patient is still convalescing from the arthrodesis performed in February 1938.

#### CONCLUSIONS

1. Aseptic necrosis of the head of the femur, following traumatic dislocation, is a serious disability. Its appearance should be looked for by means of repeated roentgenographic examinations at frequent and regular intervals.

2. In the five cases reported, clinical evidence of this complication appeared from two to five years after the initial trauma. For this reason, a traumatic dislocation should not be considered uncomplicated until at least five years after the injury.

3. If the bone changes are seen early, multiple drill holes into the head and neck of the femur may hasten reorganization of the necrotic head, with a minimum of arthritic changes. We have had no experience with this procedure, but suggest its use as a conservative measure.

4. Well-advanced cases are benefited by arthrodesis or arthroplasty, depending on the amount of destruction of the head of the femur in each case.

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## OSTEOCHONDRITIS OF THE ADULT TARSAL NAVICULAR \*

BY JAMES F. BRAILSFORD, M.D., PH.D., M.R.C.P., BIRMINGHAM, ENGLAND

Honorary Radiologist, The Royal Cripples Hospital, Birmingham, and The Warwick Orthopaedic Hospital

Serial roentgenograms of the foot of an infant with osteochondritis of the navicular (Köhler's disease) demonstrate that the disease is first revealed by a relative increase in the general density of the affected bone. This density gradually increases, apparently at the expense of general decalcification of the other tarsal bones, which after the period of from a month to six weeks, may appear to have little detail of cancellous structure and but a fine penciled outline of their peripheries. The navicular, on the other hand, is uniformly dense throughout and has its normal outline at this stage. Gradually it becomes compressed and later decalcified, but the decalcification is irregular, so irregular in some cases that the suggestion of fragmentation is given. After about one year from the onset of the lesion, all the dense islands in the bone have been absorbed, and the navicular is represented by an irregular shadow having little resemblance to that of the normal navicular. On the other hand, some degree of recalcification of the other tarsal bones has occurred, and their cancellous structure is once more clearly shown. When all the dense islands have been absorbed, regeneration becomes apparent by the appearance of the clearly defined periphery of a new navicular within which cancellous structure gradually becomes visible, and ultimately, after a period of from one and one-half to four years, a navicular of normal shape and internal architecture is seen. The only roentgenographic indication that the bone has been affected may be the faceting of its articular surfaces, due to pressure of the adjacent bone during the plastic decalcified stage. Such is the sequence of changes which may be registered either unilaterally or bilaterally in the tarsal navicular of a child during the age period from two and one-half to ten, more commonly in boys between the ages of five and six years.

Recently Dr. Iles, of Taunton, sent the author the latest roentgenograms of a boy, aged twelve, whose earlier roentgenograms, taken during the years 1932 to 1933, the writer had published.<sup>1</sup> They showed the progressive development of Köhler's disease. It was thought that the lesion had healed and that participation in normal games could be allowed, but, on examination of the roentgenograms, the deformity, which the author had learned to associate with osteochondritis of the adult navicular, was suggested. This is the first case showing a recurrence of osteochondritis in which the writer has been able to obtain serial

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FIG. 1

Lateral roentgenogram of the foot of a boy, aged twelve years, showing secondary osteochondritis of the tarsal navicular. This patient had had Köhler's disease six years previously.

roentgenograms. The roentgenographic appearances (Fig. 1) are as yet not quite identical with those lesions which develop in adult life, but the author hopes to watch the further development and to see how nearly it coincides.

Osteochondritis of the navicular in the adult does not present that sequence of changes seen in Köhler's disease. It runs a more chronic course and leads to a progressive deformity, a listhesis of the navicular, which appears to be rarely investigated roentgenographically until secondary osteo-arthritis changes are beginning to develop in the unstable mid-tarsal joint. It is then a crippling, painful deformity.

In the following nine cases of osteochondritis of the tarsal navicular in adult women, compression and division of the bone and subsequent listhesis of the separated fragments resulted.

CASE 1. Miss N. J., aged twenty-two years, a nurse, was the youngest patient in whom the author has detected these lesions. The condition had developed in both feet after four years of nursing duty. The patient could not remember any definite accident, but it is conceivable that she strained the feet in the course of her duties. She first noticed that the feet ached and were swollen at the end of the day's duties. These signs diminished with rest, but they gradually assumed such a significance that she sought surgical advice. There was no increased temperature, but, as the swelling persisted and the pain recurred at intervals, she was examined again. The patient then stated that she had felt a "crackly sensation" in the middle of the foot when she was walking. Roentgenograms of the foot were taken ten months after the onset of symptoms, and, as a result of the unusual appearances which they showed, the patient was referred to Mr. Naughton Dunn for further advice.

When examined, the feet were found to be swollen over the region of the navicular, and there was some reddening of the skin and tenderness on firm pressure over the bone. The signs were more marked on the right side. The roentgenograms of the feet taken at this time, on October 12, 1933, showed bilateral osteochondritis of the navicular.

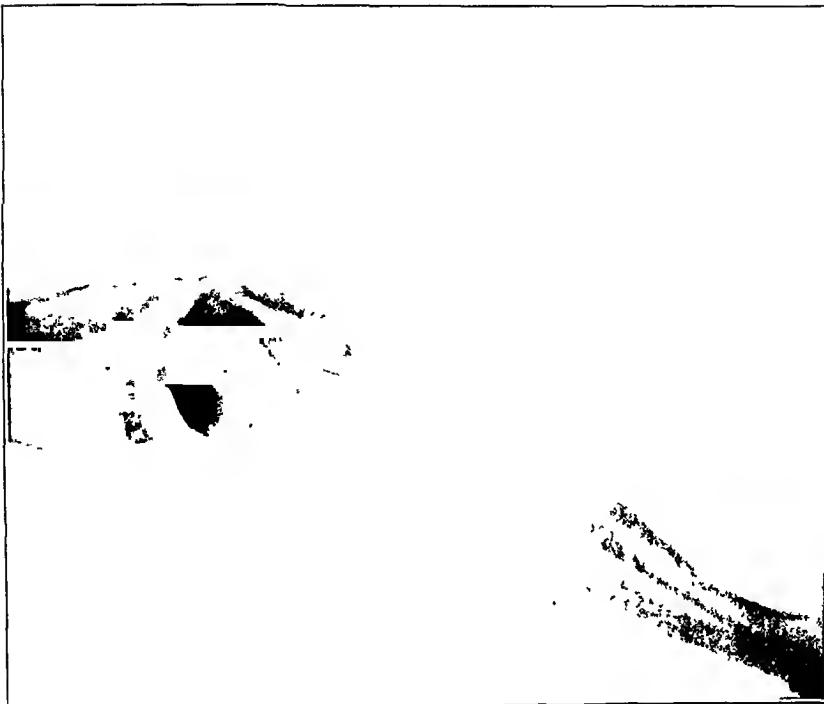


FIG. 3

Case 1. Lateral roentgenogram of right foot, showing characteristic splitting of the navicular in adult osteochondritis.



FIG. 2

Case 1. N. J., aged twenty-two years. Lateral roentgenogram of left foot, showing osteochondritis dissecans of the navicular.

On the left (Fig. 2) the lateral half of the bone was compressed to about two-thirds of the thickness of the normal medial half, and in its superior proximal surface there was a small sequestered fragment, which bore a strong resemblance to the loose body in the medial femoral condyle in osteochondritis dissecans. The remainder of the proximal subarticular bone was of increased density. No changes could be detected in the other bones of the foot. The patient had little discomfort in this foot.

The roentgenograms of the right foot (Fig. 3) showed much more extensive changes. The anteroposterior views suggested that the bone had been severed obliquely into two parts through its middle third. The lateral fragment was displaced dorsally and distally, so that it tended to override the third cuneiform. The medial half appeared to be squeezed between the head of the astragalus and the first and second cuneiforms. Later roentgenograms indicated that this fragment glided in a proximal direction over the medial surface of the head of the astragalus. The distance between the proximal surface of the second cuneiform and the head of the astragalus appeared to have been reduced by a half, and the outline of the distal surface of the lateral fragment seemed to be level with the base of the fourth metatarsal. The lateral roentgenogram showed a cleft, which appeared to run from the distal dorsal surface to the mid-point of the astragalonavicular-joint surface. The medial fragment tended to override the dorsal surface of the adjacent cuneiform, which was molded by the pressure. In this view, the fragments appeared to be a little denser than the other bones, and the cancellous structure was somewhat irregular.

Serial roentgenograms of this patient's feet during the past five years have shown a very slight but gradual compression of the lateral half of the left navicular, associated with some degree of osteoporosis of the interior of the middle third and the development in the right navicular of a small irregular area of cancellous destruction in the medial extremity of the lateral fragment, indicating an active lesion—possibly a low grade of infection. A gradual slipping of the medial fragment over the head of the astragalus has occurred, but, as yet, no secondary arthritic changes have appeared (Fig. 4). The patient

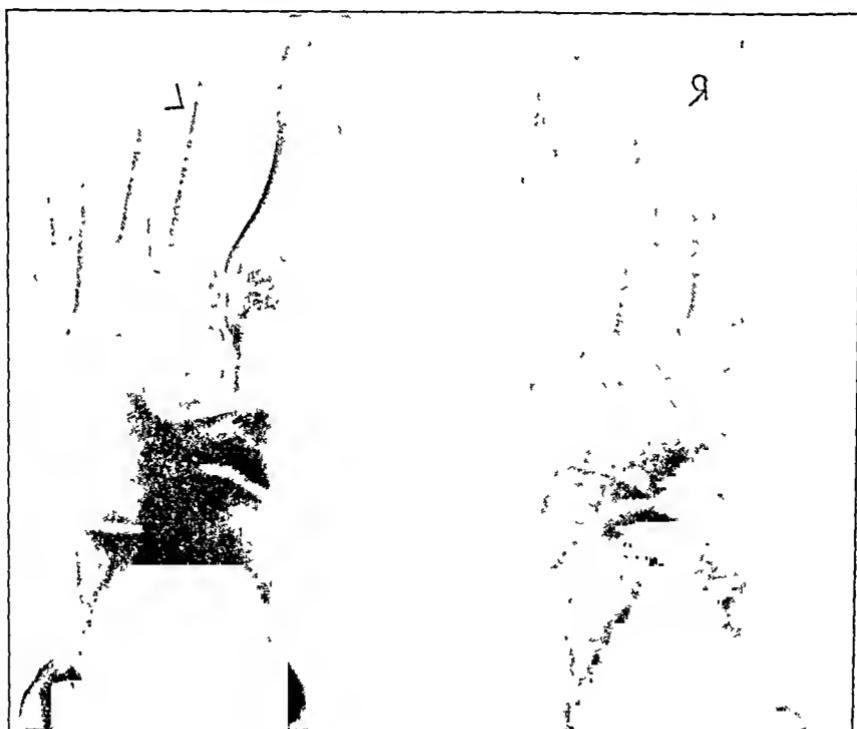


FIG. 4

Case 1. Osteochondritis of navicular. Note displacement of right fragments.

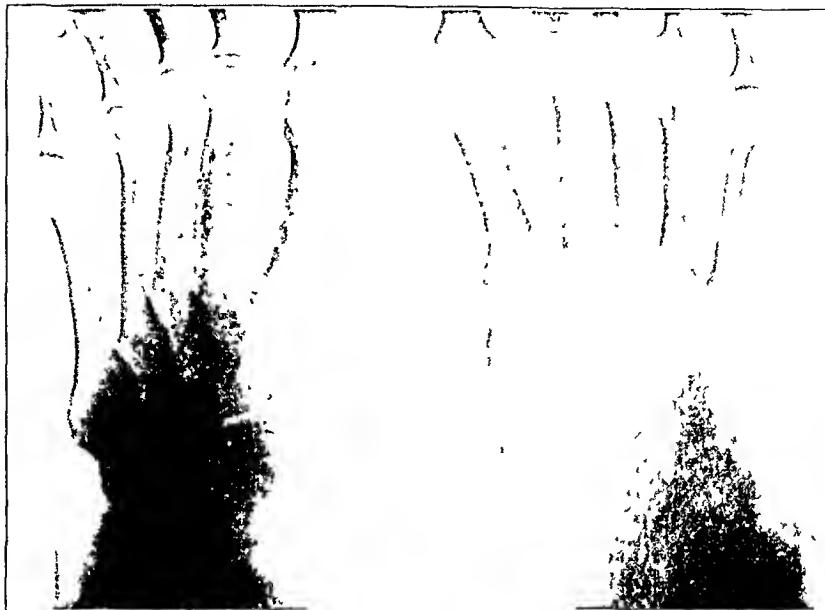


FIG. 5

Case 2. Mrs. N. S., aged thirty-two years. Anteroposterior roentgenogram, showing division of the navicular and displacement of the two fragments.

was given exercises, and is continuing her work as a nurse with little discomfort.

**CASE 2.** Mrs. N. S., aged thirty-two years, complained that her feet hurt her when she bent down. She could give no history of a definite injury. The clinical examination revealed swelling and much tenderness on pressure over the tibialis anterior tendons, and the presumptive diagnosis of tenosynovitis was made.

Roentgenograms (Fig. 5), taken on November 1, 1937, revealed a lesion in the navicular of each foot, almost identical with that described in the right foot of Case 1,—namely, an oblique separation of the navicular into two parts through its middle third. In this case, however, the fragments were more separated by the increased gliding of the

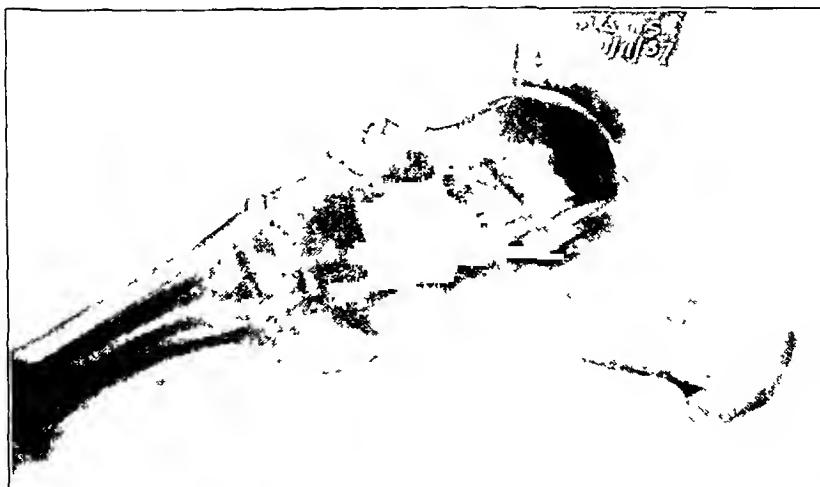


FIG. 6

Case 2. Lateral view of right foot, showing displacement of fragments.

medial fragment over the head of the astragalus and the overriding of the lateral fragment onto the dorsum of the adjacent cuneiform. (See Figure 6.) In the right foot, the early signs of chronic arthritis were shown. The second metatarsal of each foot showed hypertrophy, while the fourth and fifth metatarsals were very slender.

CASE 3. Mrs. F. C., aged fifty-two years, complained of pain in the left foot, the pain being referred to the outer aspect below the lateral malcolus and the inferior calcaneonavicular ligament, which was tender.

Roentgenograms (Fig. 7), taken on November 28, 1932, showed the characteristic splitting of the navicular of the left foot. In this case, however, the inner fragment had slipped so far medially that more than half of its articular surface projected beyond the articular surface of the head of the astragalus, so that, whereas in the normal a line projected through the axis of the first metatarsal passes through the first cuneiform, the navicular, and the axis of the astragalus, in this case the first metatarsal, the first cuneiform, and the displaced navicular fragment were in a straight line medial to the inner surface of the astragalus. In this case also, the second metatarsals were apparently hypertrophied. The first metatarsals were short, but the shafts of the third, fourth, and fifth metatarsals were atrophied. The right navicular showed irregular compression of its lateral third, as in the left foot of Case 1.

Roentgenograms (Fig. 8), taken on May 11, 1938, revealed that severe osteo-arthritis changes had developed in the abnormal astragalonavicular joint of the left foot,—namely, destruction of the articular cartilage, eburnation and erosion of the adjacent bone surfaces, and lipping of the articular margins. The lateral fragment was almost completely displaced onto the dorsum of the adjacent cuneiform.

CASE 4. Mrs. A. S., aged forty-five years, complained that she could not walk because of pain in her feet. Her shoes had previously been distorted by wear.

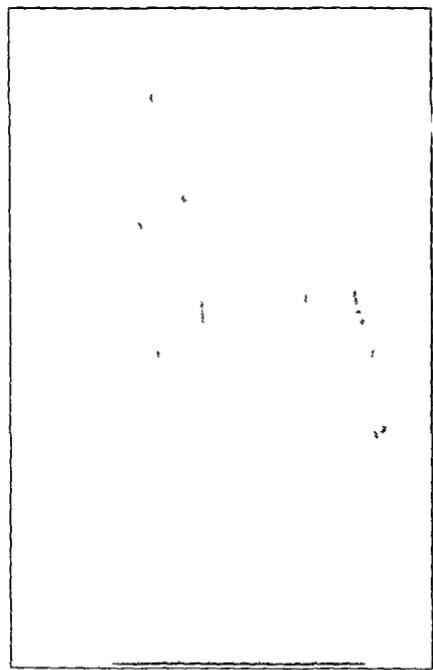


FIG. 7

Case 3. Mrs. F. C., aged fifty-two years. Roentgenogram, taken on November 28, 1932, showing marked medial displacement of inner fragment of navicular.

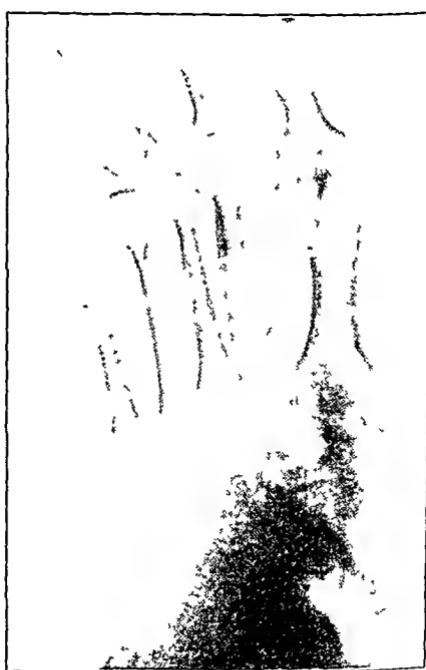


FIG. 8

Case 3. Anteroposterior roentgenogram, taken on May 11, 1938, showing severe secondary arthritic changes in the mid-tarsal joint.

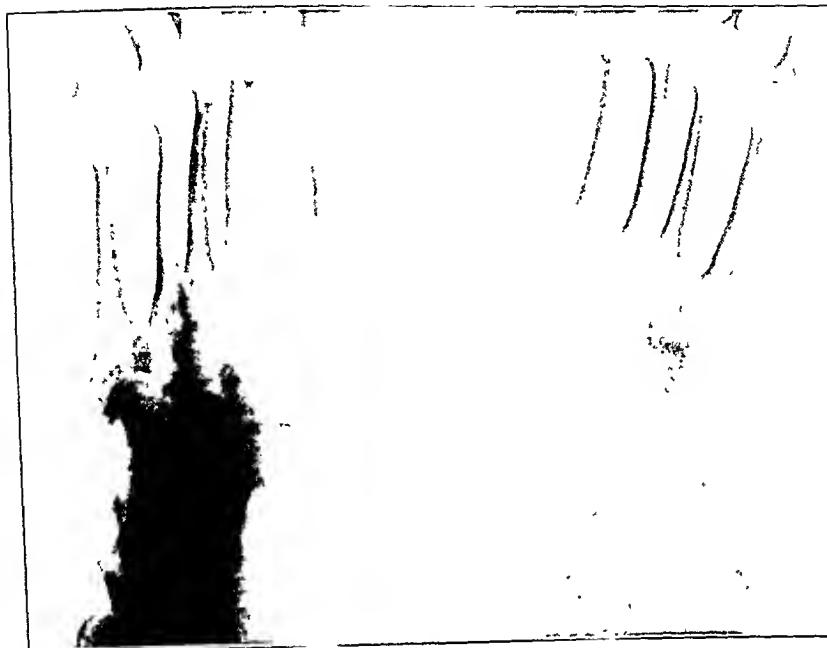


FIG. 9

CASE 4. Mrs. A. S., aged forty-five years. Anteroposterior roentgenogram, showing marked medial displacement of the inner fragment of the navicular. Note the alignment of this fragment with the cuneiform and the metatarsals.

Roentgenograms (Fig. 9), taken on September 20, 1937, showed bilateral division of the navicular into two parts with such marked medial projection of the inner fragment that the axes of both the first and second metatarsals and their cuneiforms were medial to the inner surface of the astragulus, instead of in the normal position, in which the axis of the first metatarsal is in line with the axis of the astragulus. In addition, there were very severe osteo-arthritis changes, more marked in the right than in the left astraganoavicular joint. The right cuboid also appeared to be involved. In this case, the first metatarsals were short, the second metatarsals were hypertrophied, and the third, fourth, and fifth metatarsals were markedly atrophied.

CASE 5. Mrs. S. R., aged fifty-two years, complained of pain in both feet, which had been gradually progressing for many years.

Roentgenograms, taken on October 20, 1930, revealed the characteristic splitting of the navicular in both feet, associated with the displacement recorded in the other cases, and with severe arthritis. The changes were most severe in the left foot, in which the cuboid was involved, and the head of the astragulus showed a small area of subarticular cancellous destruction. There was no hypertrophy of the second metatarsals, nor appreciable shortness of the first metatarsals, but there was some atrophy of the third, fourth, and fifth metatarsals.

CASE 6. Mrs. E. D., aged fifty-six years, complained of pain, with swelling around the left ankle, the pain being worse in the foot. She later complained of pain in the left knee, and more recently in the left lom.

Roentgenograms, taken on April 7, 1936, showed the characteristic lesions in both feet, with less displacement and deformity of the fragments than in the previous cases. The metatarsals, apart from some osteoporosis of the fifth, showed little departure from the normal.

Roentgenographic examination on May 10, 1938, disclosed evidence of secondary arthritic changes in the deformed joint surface.



FIG. 10

**CASE 9.** Miss P. W., aged fifty-one years. Lateral roentgenogram, showing deformity due to osteochondritis of the navicular.

**CASE 7.** Miss A. P., aged fifty-seven years, stated that she had always had severe valgus deformity of the left foot, which until a few years previously had not been associated with much discomfort. At the time of examination she had dropping of the longitudinal arch and some adduction of the forepart with complete mesial displacement of the navicular on the head of the astragalus.

Roentgenographic examination, on March 18, 1935, showed the characteristic lesion with marked displacement of the medial fragment of the left navicular, associated with severe osteo-arthritis. Osteo-arthritic changes were also evident in the first metatarsocuneiform joint and in the distal cuboid articulations. There were also visible slight changes in the right navicular, similar to those in the right foot of Case 1.

**CASE 8.** Mrs. J. M., aged fifty-nine, complained of pain and swelling in the legs after standing. There was a doubtful history of injury to the right foot nine years previously.

Roentgenographic examination, on May 16, 1934, showed characteristic deformity of the navicular of each foot. In the right foot, this deformity was associated with marked displacement of the fragments and arthritic changes.



FIG. 11

**Mr. A. S.,** aged thirty-one. Lateral roentgenogram, taken on June 30, 1932, showing deformity of the navicular due to old injury.

**CASE 9.** Miss P. W., aged fifty-one years, complained of pain and swelling of the right foot.

Roentgenograms (Fig. 10), taken on March 28, 1938, revealed the characteristic deformity of the navicular with collapse of the arches in the right foot and marked displacement of the fragments in the manner previously indicated. Less severe changes were shown in the left foot.

No cases presenting similar roentgenographic appearances were observed in men. In the roentgenograms of several men the appearance of the tarsal navicular was somewhat similar to that seen in Kienböck's disease of the lunate. These patients all gave a history of injury.

Mr. A. S., aged thirty-three years, a labourer, was claiming compensation. He had given a history of injury to his foot, caused by a fall from a ladder two months previously. The clinical examination suggested to the surgeon that a fracture of the metatarsus had been sustained. In the lateral roentgenograms, the appearance of the navicular resembled Kienböck's lunate malacia, an example of which the author already had in his collection. The anteroposterior roentgenogram did suggest separation into two parts through the middle third of the bone. On comparing the roentgenograms of this patient with the one already in his collection, which had been taken two years previously, the author was struck by the similarity. (See Figures 11 and 12.) The appearance was so similar that, although the films had been taken at another hospital and bore a different name and the man denied any previous injury or medical examination, it was possible to prove identity. In this patient, there was no sign of disease in the navicular of the other

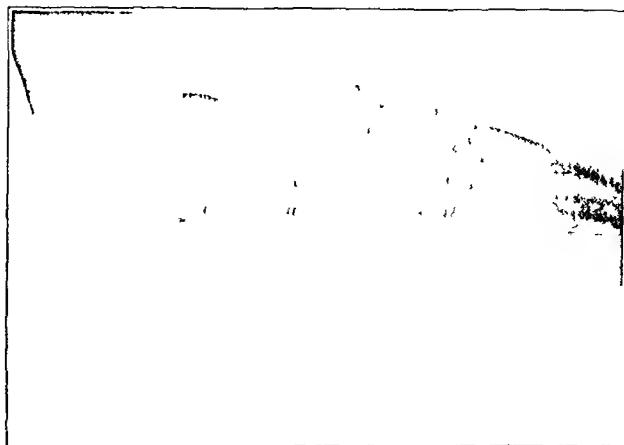


FIG. 12

Mr. A. S. Lateral roentgenogram, taken on September 19, 1934, showing deformity of the navicular due to old injury. Note the similarity to Fig. 11 in structure and outline.



FIG. 13

Mr. A. L., aged fifty-one years. Lateral roentgenogram, showing changes of the nature of osteochondritis in the navicular and upper adjacent surface of the astragus. The appearance of the lesion in both feet was identical.

foot, and, from a study of serial roentgenograms of fractures of the navicular in other patients, the writer is satisfied that the appearances were the result of an old fracture.

Rather a different appearance was seen in a second man, A. L., aged fifty-one years, who complained of pain in the right heel of several months' duration. The left foot was perfectly comfortable. The movements of the right ankle were somewhat restricted, and there was some swelling over the navicular. There was no history of trauma. Roentgenograms (Fig. 13), taken on November 8, 1934, showed an unusual deformity of the navicular in each foot and changes in the cancellous structure and in the head of the astragalus, which suggested lesions of the nature of osteochondritis.

#### SUMMARY

The characteristic lesion in the nine cases of osteochondritis of the tarsal navicular in adult women which have been described is an oblique splitting of the navicular and separation of the two fragments: the inner fragment gradually glides over the head of the astragalus to its medial side; the outer fragment overrides the dorsal surface of the second and third cuneiforms. This breach between the two fragments reduces the distance between the proximal articular surfaces of the second and third cuneiforms, on the one hand, and the head of the astragalus, on the other, and ultimately these cuneiform surfaces may even articulate with the head of the astragalus. In the later stages, severe osteo-arthritis changes develop in the abnormal mid-tarsal joint. A lesion of this severity may be found on both sides. More frequently, however, while one side presents the appearances described, the other shows less extensive changes such as osteochondritis dissecans or mere compression of the plastic outer third of the navicular. All of these nine patients showed evidence of pathological changes in the navicular of each foot.

The ages of the affected patients were as follows: twenty-two, thirty-two, forty-five, fifty-one, fifty-two, fifty-two, fifty-six, fifty-seven, and fifty-nine. In the two younger patients, no secondary arthritic changes could be detected in the affected bones, but in all the others, with the exception of Case 3, marked osteo-arthritis changes were evident. The roentgenograms of Case 3, when the patient was fifty-two years of age, showed almost complete medial dislocation of the inner fragment of the navicular, but no secondary arthritic changes were detectable. Six years later, severe arthritic changes were observed. This suggests that the displacement had occurred within a year or so of the first roentgenographic examination.

In three patients—Cases 2, 3, and 4—the first metatarsal was short, the second metatarsal was hypertrophied, and the third, fourth, and fifth metatarsals were atrophied. The other cases did not demonstrate these features, although in Cases 5 and 7 some atrophy of the metatarsals was suggested.

No cases presenting similar roentgenographic appearances were observed in men.

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# RUPTURE OF THE NUCLEUS PULPOSUS

## AN ANATOMICAL STUDY

BY MARTIN BATTS, JR., M.D., ANN ARBOR, MICHIGAN

*From the Department of Surgery, University of Michigan*

The clinical recognition of rupture of the nucleus pulposus has been a very recent development. The rapidly increasing frequency with which this anatomical lesion is being found prompted a study of fifty cadavers upon whom no clinical data had been obtained.

Rupture of the nucleus pulposus has been reported in the cervical, thoracic, and lumbar regions. This study is limited to the lumbar spine, in which by far the greatest number of lesions has been found.

Permanent protrusion of disc substance may occur in any direction. Of the fifty spines examined, there were ten cases (20 per cent.) of protrusion of the disc into the bodies of the adjacent vertebrae; eight cases (16 per cent.) of rupture of the nucleus pulposus posteriorly into the spinal canal; and three cases (6 per cent.) of anterior protrusion. The terms "protrusion of the disc" and "rupture of the nucleus pulposus" are not used interchangeably. Protrusion may refer only to the annulus fibrosus, in which there is no solution of continuity. Rupture of the nucleus pulposus refers to an actual break in the annulus or the cartilage plate with extrusion of the nuclear contents.

Figure 1 shows an anterior protrusion of the disc substance covered by osteophytic proliferation. The space occupied by the nuclear contents projects farther anteriorly than the anterior surface of the vertebral bodies. The frequency with which disc substance is found projecting beyond its normal limits in this hypertrophic lipping and bridg-



FIG 1

A mid-sagittal section through two adjacent vertebral bodies and intervertebral discs. The upper disc is normal. The lower disc is thinned out, and the nucleus has been extruded anteriorly, where it is covered by osteophytic proliferation and bony bridging between the anterior portions of the vertebral bodies.

ing suggests that the bone change may be secondary to the changes in the disc.

Figure 2 shows extrusion of the nucleus pulposus through a break in the cartilage plate. This occurred in 20 per cent. of the cases. The

roentgenologists have named this lesion "Schmorl's nodule". Schmorl's monumental work links him inseparably with any study of the intervertebral disc, and he found



FIG. 2

A mid-sagittal section of the lumbar spine, showing the typical Schmorl's nodules, or rupture of the nucleus pulposus through the cartilage plates into the adjacent vertebral bodies.



FIG. 3

A sagittal section through two intervertebral discs and adjacent bodies five millimeters from the mid-line. The upper disc is normal. The lower disc shows a rupture of the nucleus pulposus and the formation of a tumor, which bulges posteriorly into the spinal canal.

this lesion to exist in 38 per cent. of the cadavers examined in routine autopsies.

Posterior herniation into the spinal canal, which is usually thought of in a discussion of ruptured nucleus pulposus, was studied in the following way. The back muscles were removed, and the vertebrae were exposed down to the transverse processes. The entire neural arch was then removed at the junction of the pedicles and the bodies of the vertebrae. The nerve trunks passing through the intervertebral foramina were left *in situ*. The dura was then opened in the mid-line; the cauda equina

was separated; the lumbar cord was split; and the anterior dura was incised in the mid-line and retracted laterally. The epidural connective tissue and vessels were removed, and the posterior surfaces of the vertebrae and intervertebral discs were completely exposed. Uniformly in the lumbar region the discs were seen to protrude farther posteriorly than the bodies of the vertebrae. The protrusion was slight and symmetrical. However, in eight cases, there was a greater protrusion on one side, and, in two of these, there were definitely localized tumefactions, which caused pressure on the neighboring nerves. The lumbar and upper sacral portions of the spine were then removed from the cadaver, and sagittal sections were made in thicknesses of five and ten millimeters. In a few of the specimens, transverse sections of the discs were made.

Figure 3 shows a posterior rupture of the nucleus pulposus, which did not cause any pressure on the neighboring nerves. The vertical diameter of the disc is but slightly decreased. Various observers have found that only one-third of the proved cases of rupture show narrowing of the disc by roentgenographic examination.

Figure 4, a transverse section of an intervertebral disc, shows a ruptured nucleus pulposus. There is a

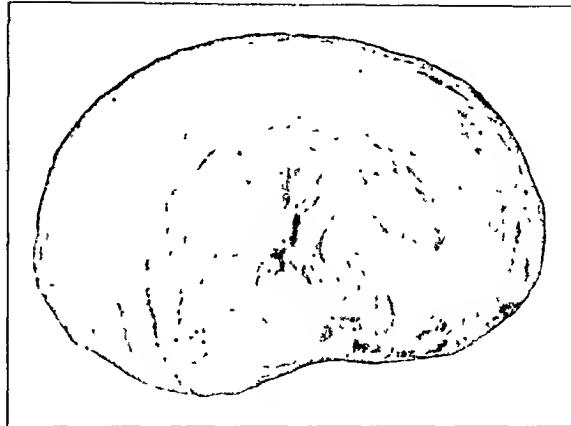


FIG. 4

A transverse section of an intervertebral disc, showing a ruptured nucleus pulposus. The size of the tumor may be judged by comparing it with the opposite side.

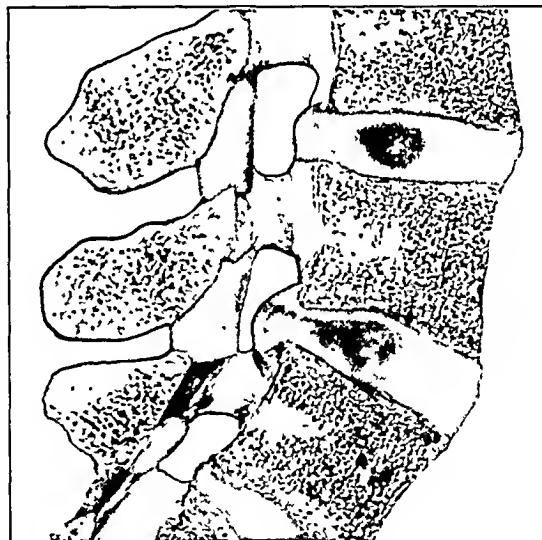


FIG. 5

A mid-sagittal section of the lower two lumbar and upper sacral segments of a reconstructed spine. The intervertebral discs and ligamenta flava are represented by molded wax. The central disc is represented as ruptured posteriorly, and the ligamentum flavum in this area as hypertrophied. The ruptured disc encroaches upon the intervertebral foramen, thus compressing the nerve having its exit between the tumor and the pedicle above. The nerves having their exit below would be compressed in the narrowed space between the ruptured disc and the ligamentum flavum.



FIG. 6

A view of the posterior aspect of the vertebral discs and posterior longitudinal ligament, with the cauda equina retracted laterally. The pedicles have been cut at the junction with the vertebral bodies, and the entire neural arch has been removed. The arrow indicates the ruptured disc.

amentum flavum posteriorly. The disc between the fourth and fifth lumbar vertebrae represents a rupture of the nucleus pulposus posteriorly into the spinal canal. There is marked encroachment upon the intervertebral foramen at this level, and a marked diminution in the space between the tumefaction and the ligamentum flavum. These anatomical alterations cause pressure on the neighboring nerves, which is responsible for the symptoms associated with such a lesion.

Whether a rupture of the nucleus pulposus will cause symptoms is dependent upon its location and size. Posterior ruptures in this series were always unilateral. The presence of the posterior longitudinal ligament is probably responsible for the fact that they were not found in the mid-line. A small tumor near the mid-line probably would not produce symptoms. Larger tumors situated posteriorly do produce symptoms.

definite break in the annulus, with herniation of the nucleus, which is covered only by a thin layer of fascia. The ease with which the nuclear material can be plucked out at operation by simply grasping it with forceps is evident from this photograph. The size of the tumefaction may be judged by comparing it with the posterior aspect of the disc on the opposite side.

Figure 5 is a mid-sagittal view of a reconstructed spine. The intervertebral discs and the ligamenta flava connecting the laminae are represented by molded wax. It will be noted that the intervertebral foramina are relatively large, and that there is considerable space between the normal disc anteriorly and the lig-

Of the eight posterior ruptures, two were found in this location, and were of sufficient size to impinge upon the neighboring nerves.

Figure 6 is an unretouched photograph of a posterior rupture of the nucleus pulposus at the level of the fourth lumbar intervertebral disc. The posterior surface of the bodies of the vertebrae with the intervertebral discs and the cut surface of the pedicles are shown. The cauda equina has been retracted laterally. The posterior longitudinal ligament is well shown, and it is evident that this ligament reinforces the discs posteriorly, and also that it decreases in size as it approaches the sacrum. This rupture was just lateral to the mid-line and was not of sufficient size to impinge upon the neighboring nerves.

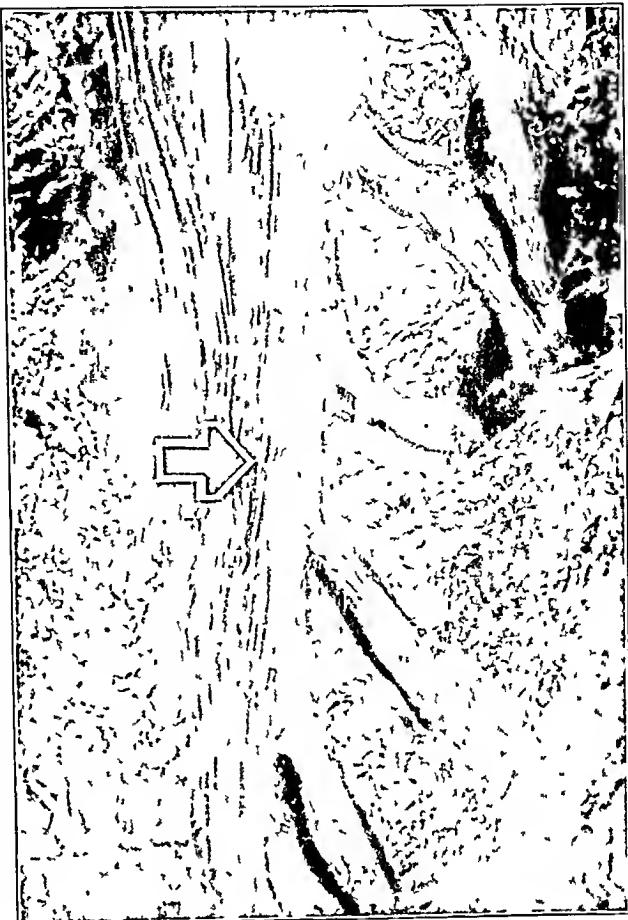


FIG 7

A view similar to that shown in Fig 6, but of another lesion and with the spinal nerves on one side *in situ*. The arrow indicates the posterior bulging of the ruptured disc, which compressed the nerve having its exit just above. The nerve immediately below is seen passing over the tumor and is displaced posteriorly.

Figure 7 demonstrates a posterior rupture of the nucleus pulposus at the level of the fifth lumbar intervertebral disc, with the lumbar and sacral nerves *in situ*. The fourth lumbar nerve is compressed between the pedicle above and the ruptured disc below, and, even in this post-mortem photograph, the swelling of the nerve trunk is evident. The extent of the protrusion may be judged by the depth of the depression just above it. The nerve trunk, having its exit below, passes over the tumor, and, in all probability, was compressed between the tumor and the ligamentum flavum.

In conclusion, rupture of the nucleus pulposus is a common lesion. It may occur in any direction. However, as commonly referred to, it is taken to mean rupture posteriorly with protrusion into the spinal canal.

Schmorl found that this posterior rupture of the nucleus pulposus existed in 15 per cent. of the cadavera examined in routine autopsies. He was of the opinion that it did not cause symptoms. In comparison, this small series has shown rupture of the nucleus pulposus posteriorly in 16 per cent., with the strong probability that it was responsible for symptoms in 4 per cent. of the cases studied.

The author wishes to express his sincere appreciation to Dr. Rollo E. McCotter, of the Department of Anatomy, whose cooperation made this study possible.

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# MORPHOLOGICAL CHANGES ACCOMPANYING FIXATION OF THE BICEPS TENDON (NICOLA OPERATION)

## AN EXPERIMENTAL STUDY ON ANIMALS

BY W. I. NORTON, B.S., O. A. MORTENSEN, M.D., AND W. E. SULLIVAN, PH.D.,  
MADISON, WISCONSIN

*From the Department of Anatomy, University of Wisconsin*

Transplantation of the long head of the biceps tendon was introduced by Nicola in 1929 as a treatment for recurrent dislocation of the shoulder joint. The tendon is divided near its fleshy end and freed from the intertubercular sulcus. The free end is threaded through a canal made in the proximal end of the humerus, which extends from the articular surface to the lower edge of the transverse humeral ligament. The tendon is re-united to the muscle belly, and sutures are placed through the periosteum to relieve tension on the transplanted portion.

In all, about twenty-five animals (dogs and rabbits) were operated on in this manner, and the morphological changes which accompanied fixation of the transplanted portion of the tendon to the walls of the bone canal were studied. The limb was not immobilized postoperatively, except for the protective self-splinting on the part of the animal. The animals were killed at intervals of from four days to nine months, and the condition of the transplanted tendon was studied grossly and microscopically. In all cases, when a reasonable period of time had elapsed after transplantation, fixation of the tendon to the bone had occurred. In some instances, fraying and even separation of the intracapsular portion were observed. This was attributed to faulty placing of the canal.

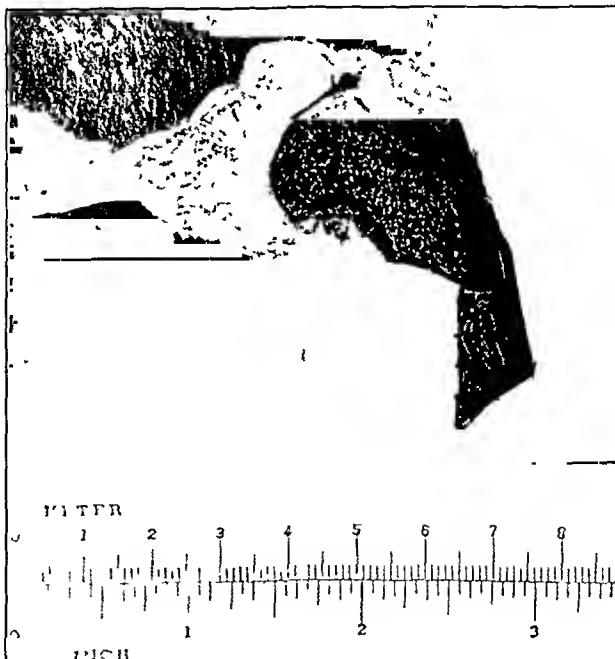


FIG. 1

Showing the position and fixation of a transplanted tendon from a dog, three months after operation.

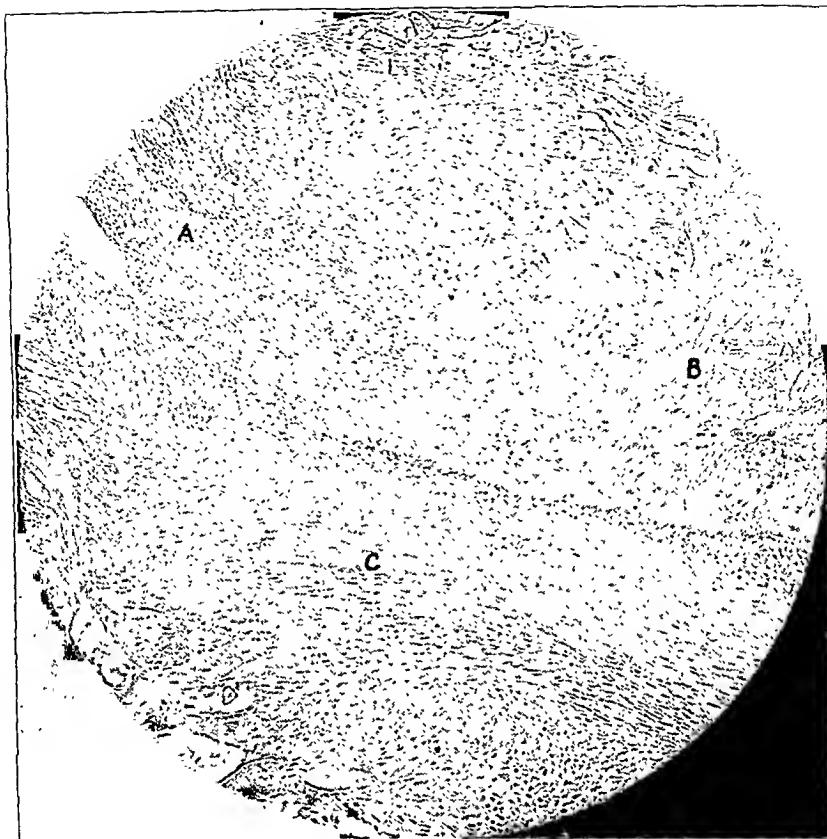


FIG. 2

Section of specimen taken from a dog nine months after operation, showing proximal end of canal. *A* indicates fibroblastic invasion of the tendon; *B*, clumping of the nuclei and hyalinization; *C*, connective tissue proliferated from the margin of the canal.

The earlier stages of the fixation process were studied in a series of rabbits. These animals were sacrificed at five-day intervals during the period between the fourth and the twenty-ninth postoperative days. During this period, the clot is organized, and the tendon is invaded and fixed by the proliferation of a vascularized connective tissue from the margin of the bone canal.

In the four-day specimen, the area between the tendon and the wall of the canal is largely occupied by a fibrinous exudate, which is being invaded by an outgrowth of young fibroblastic tissue from the bone margin. At the end of nine days, the exudate is almost entirely replaced by a connective tissue in which small arterioles are present. The organization tissue is invading the tendon and separating the peripheral tendon bundles from the main mass. The fibrous tissue adjacent to the bone margin is further differentiated in the fourteen-day specimen into rather dense bundles, which are arranged in a concentric manner. The margin of the bone canal shows marked osteogenic activity. Sections, particularly from the distal portion of the canal, at intervals of nineteen, twenty-four,

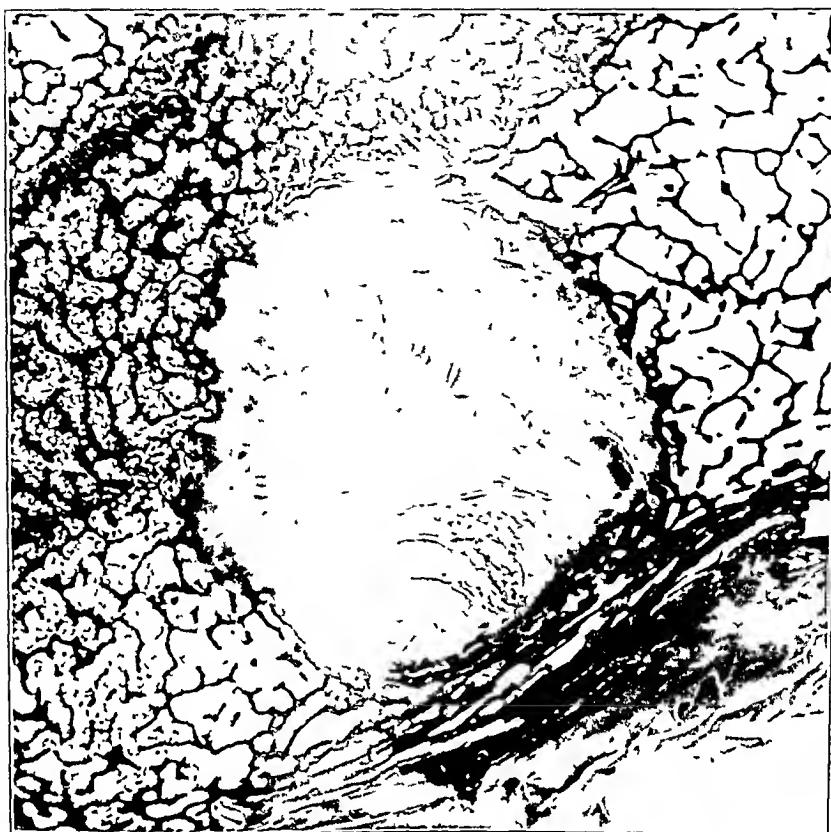


FIG. 3

The middle portion of the canal. Note the firm fixation to the bone margin, separation of the tendon bundles, and deposition of fat.

and twenty-eight days, indicate very firm fixation and invasion and separation of the tendon bundles to the extent that it is difficult to differentiate the original tendon from the newly formed connective tissue.

Observations of the fixation process, covering a postoperative interval of from one to nine months, were made on a series of ten dogs. Gross dissection revealed firm fixation of the tendon to the walls of the bone canal and, in a few instances, fraying or buckling of the intracapsular portion. The left shoulder of Dog No. 4 was selected for microscopic study, because the intracapsular portion of the transplanted tendon appeared normal after a postoperative interval of nine months. Serial sections of the entire intra-osseous portion of the transplanted tendon were prepared, and a brief description of the morphological changes follows.

The tendon is not attached to the articular cartilage. It is surrounded and separated from the cartilage by a shallow trough-like extension of the joint cavity. As soon as the osseous portion of the canal is entered, invasion and fixation of the tendon by a vascularized connective tissue is evident. This invasion and separation of the tendon bundles becomes more complete as one examines the sections from the proximal

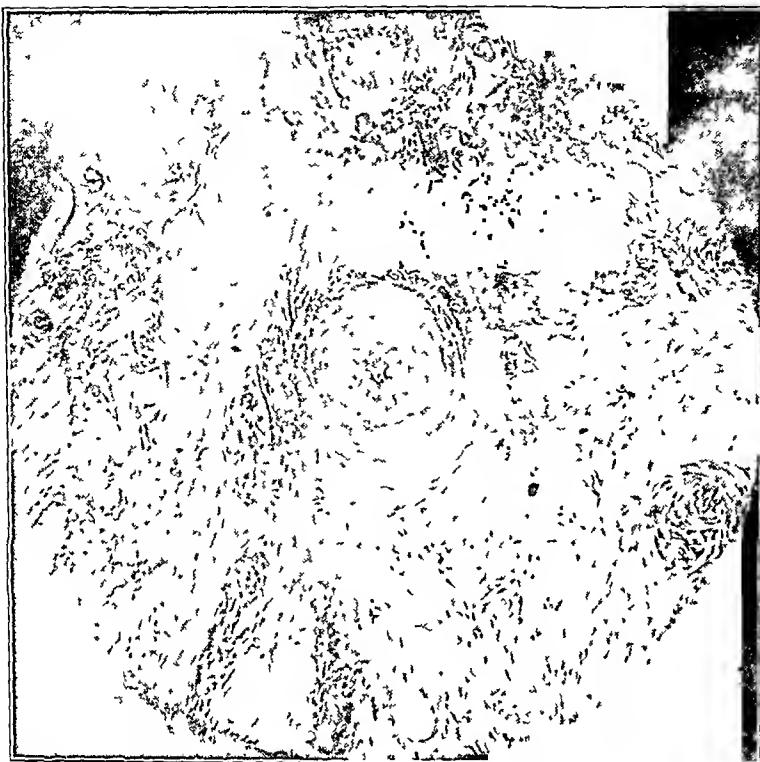


FIG. 5

Higher magnification to demonstrate marked degenerative changes of the vessel wall.



FIG. 4

Higher magnification of a small area from the margin of Fig. 3  
Note extreme vascularity, thickening of vessel walls, and distribution  
of fat

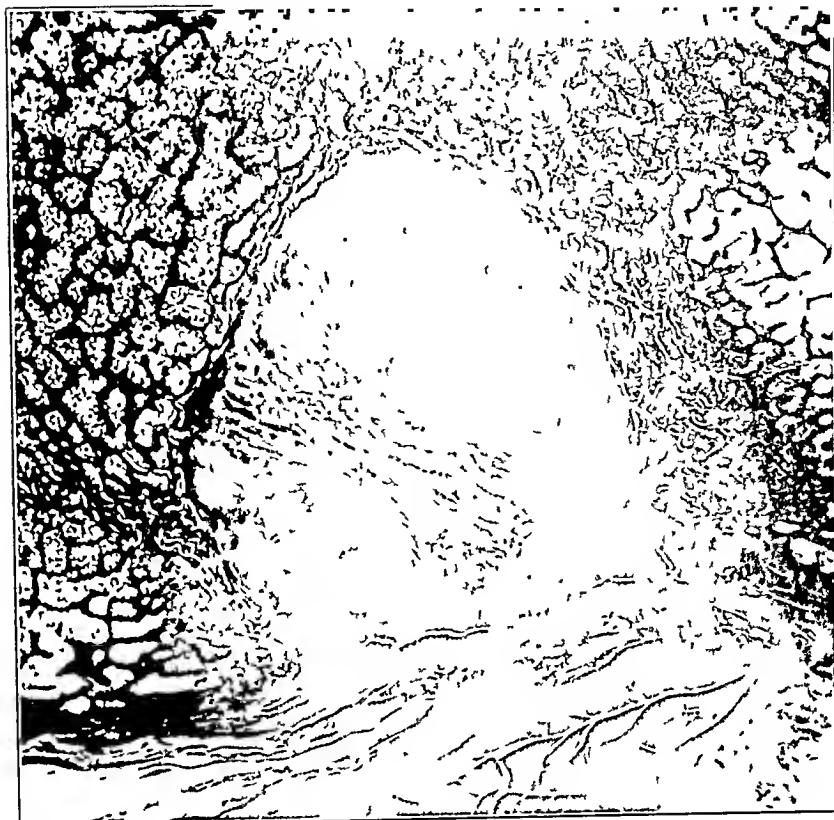


FIG 6  
Section through the distal end of the canal.

toward the distal part of the canal. In fact, when the middle portion of the canal is reached, it is impossible to distinguish accurately the true tendon bundles from the newly proliferated connective tissue. There are also evidences of degeneration of the tendon fibers, such as the loss of their nuclei and hyalinization, and to what extent the tendon is actually replaced by a new tissue is difficult to estimate.

The microscopic picture of the nine-month postoperative specimen differs from the more acute picture, which has already been described in the rabbit series, in two respects,—namely, the deposition of fat and the marked degenerative changes in the walls of the blood vessels. The deposition of fat frequently accompanies fibrosis, and is particularly prone to occur in chronic fibrotic areas. The degenerative changes in the arterial walls are of an endarteritic character, and have been interpreted as compensatory to a reduction in the blood supply, which invariably accompanies the change from an acute to a chronic fibrosis. New bone has been proliferated within the margin of the canal, forming a thin, almost complete, compact layer adjacent to the fibrous tissue. This is particularly evident over the anterior portion of the canal in its distal part.

## DISCUSSION

Transplantation of tendon into or through bone is a frequent orthopaedic procedure. However, descriptions of the morphological changes which result in the attachment of the tendon are not readily available. Gallie described an operative procedure in which the tendon of a paralyzed or partially paralyzed muscle is transplanted, in order that it may serve as a retaining ligament. In one instance, he had the opportunity to study the fixation of the peroneal tendon one year after it had been placed in a groove gouged in the fibula. He reported the following findings: "The microscopic appearances show the tendon united intimately to the subjacent bone by short bands of fibrous tissue. These fibers run around and through the tendon and are very intimately attached to the bone." Gallie also reported an instance in which a tendon was transplanted with its sheath intact, with resulting failure to obtain fixation. Fixation resulted in our experiments, although no deliberate scarification was done.

In conclusion, it may be said that firm fixation of the transplanted biceps tendon to the walls of the artificial canal takes place. This tendino-osseous union is accomplished by the proliferation of a vascularized connective tissue from the margins of the bone canal. The microscopic sections nine months after operation may not represent the final picture of the fixation process.

We wish to acknowledge the help of Messrs. Lozoff, Kozall, and Grindell, who operated on a number of the animals included in this study.

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NICOLA, TOUFICK: Recurrent Anterior Dislocation of the Shoulder. A New Operation. *J. Bone and Joint Surg.*, XI, 128, Jan. 1929.

# INJURIES TO THE CARTILAGES OF THE PATELLA AND THE FEMORAL CONDYLE \*

BY PROF. V. D. CHAKLIN, SVERDLOVSK, U.S.S.R.

Out of a total of 159 cases involving operation on the knee, seen at the Ural Institute of Traumatology and Orthopaedics in the course of the last five and one-half years, we have had the opportunity of observing and carrying out research on thirty-eight cases involving the cartilages of the patella and the femoral condyle, in which unique changes had taken place.

*Clinically*, we differentiate cases of recent injury to the cartilage from cases of chronic changes of the chondropathic type. Illustrative of the difference is a case in which operation was performed for a *recent injury* to the knee joint. On the second day after injury, operation disclosed a defect in the cartilage of the patella, involving an area two by three centimeters, and in the lateral bursa of the synovial membrane a free torn-off portion of the cartilage was found. (See Figures 1-A and 1-B.)

In other cases, in which operation was carried out during a quiescent period, there were noted quite diversified changes on the cartilage surface of the patella; in four cases, such changes were observed on the cartilage of the femoral condyle.

In a series of operative cases, we were able to discern different phases in the pathological changes of the cartilage. In most instances, changes of a chondropathic type are to be observed on the medial side of the lower region of the patella. Macroscopically, the early stage takes the form of an isolated portion or region which becomes soft and breaks down into a fibrillar condition of the cartilage. The surface undergoing change becomes covered with a fine "plush" of the appearance of velvet, and a slight depression develops. The changes invade the bony parts at some points.

In the more advanced stages, the necrobiotic portions of the cartilage become detached and enter the joint. Owing to the extremely weak regenerative powers of the hyaline cartilage, at the site of injury there is formed a hollow space similar to an ulcerous cavity, the bottom of which is covered over by a portion of the necrotic cartilage tissue. In places *deep cracks* are visible in the cartilage. (See Figure 2.)

Another type of pathological change which may sometimes be observed consists of a simultaneous involvement of the cartilage of the patella and the corresponding femoral condyle, usually on the anterior surface of the latter. Besides this, there may also be found a tubercle-like growth at the margin of the cartilage defect. Corresponding to the position of the growth, on the femoral condyle there is a localized cavity on the bottom of which may be observed a fibrillar condition.

\* Read before the Leningrad Military Medical Academy.

A third variation of the pathological changes which may occur consists of the appearance of a *deep crack* on the center of the patella. The crack penetrates to the bone tissue; there are no changes in the cartilage on the surface of the femoral condyle. (See Figure 3.)

In all cases (except recent ones) there were found areas having the appearance of a synovitis caused by some irritation. In rare cases there was observed a combination of injury to the cartilage and injury to the medial meniscus.

The foregoing description differentiates injuries to the cartilage of the patella from osteochondritis dissecans of König. Osteochondritis dissecans usually occurs in the knee at the point of greatest impact,—

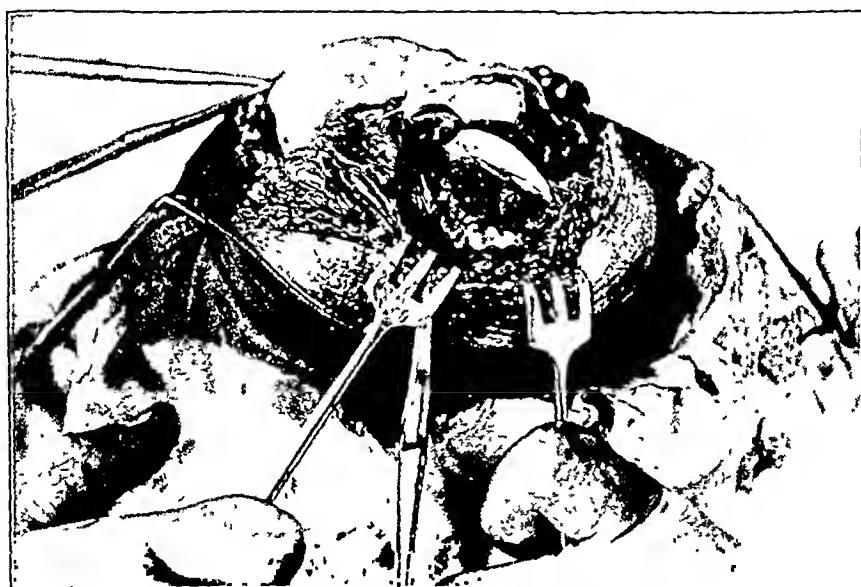


FIG. 1-A

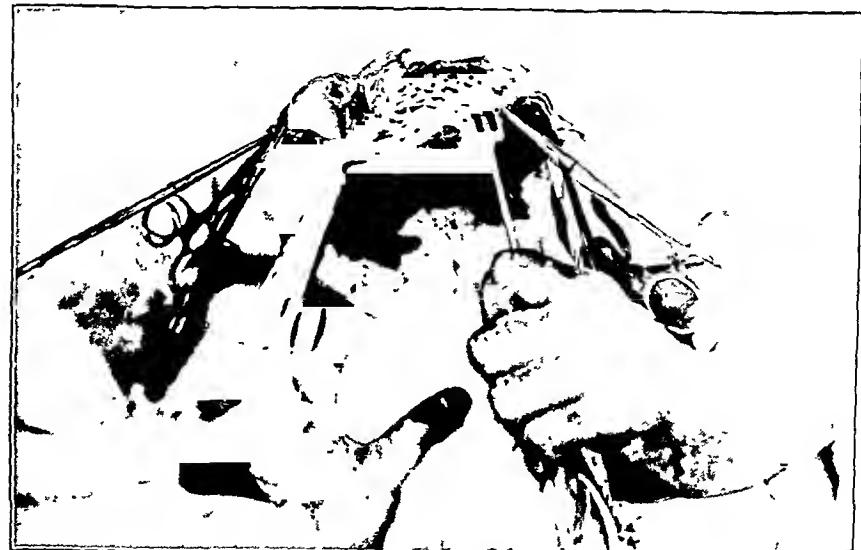


FIG. 1-B

namely, at the lateral portion of the surface of the medial condyle adjacent to the intercondylar notch. The bed from which the free body has been torn off becomes covered with cartilage tissue; the process of separation takes place slowly; and the condition becomes chronic. Not once in such cases have we observed injury to the cartilage of the patella. A different picture is to be observed at operation and on histological examination in cases of so-called traumatic chondritis of the patella. Acute cases are characterized by a unique growth of the cartilage; chronic cases, by the symptoms of arthritis deformans. Therefore, Läwen recommends early operative measures to ward off the development of arthritis deformans.

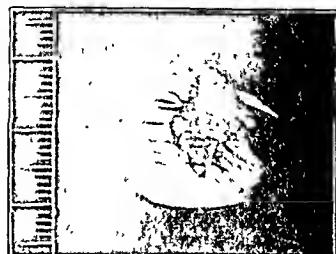


FIG. 2

#### PATHOGENESIS

The changes just described must be considered as being due to *traumatic injuries* to the cartilage.

The *mechanism* of the trauma is the direct application of force in the region of the patella or femoral condyle. The usual mechanism consists of a fall on the knee or contusion from a hard object. Under these conditions, the patella, forced against the femur by a sudden contraction of the quadriceps muscle, is subjected to stresses sufficient to destroy the cartilage, but insufficient to effect a fracture. The injured cartilage undergoes further degeneration and changes: necrobiosis, necrosis, breaking down into a fibrillar condition, exfoliation, and sequestration (Fig. 4).

Due to the extremely slow regeneration, to the absence of or only weakly developed vascular elements, and to the sluggish reactions of the cartilage, the defect fills in very slowly. Treatment with the view to effect cure by cicatrization holds out but little hope, especially in the presence of a considerable defect. The torn-off small portions of cartilage fall into the joint and are found in the form of free bodies. There then develops the picture of chronic (non-infectious) synovitis with a hyperaemic synovial membrane, followed by the formation of the plushy growth, which attains to considerable size. There is periodic exudation.

In the vascular pannus covering over the joint cartilage, there take place changes which, in the final analysis, form the picture of arthritis deformans. Läwen, in thirteen operative cases and in forty-four cadavera, observed



FIG. 3

cracks in the cartilage of the patella in many cases, but in only one case did he note a crack in the cartilage of the femoral condyle. He also observed that cracks and crevices never reach the bone. At the same time, he noted in one joint acute or chronic synovitis, which seemed to have been secondary. Etiologically, Läwen considered his cases to be the result of trauma or of wear and tear on the joint consequent to heavy work. In certain cases, the use of the roentgen-ray makes possible the detection of the early signs of arthritis deformans.

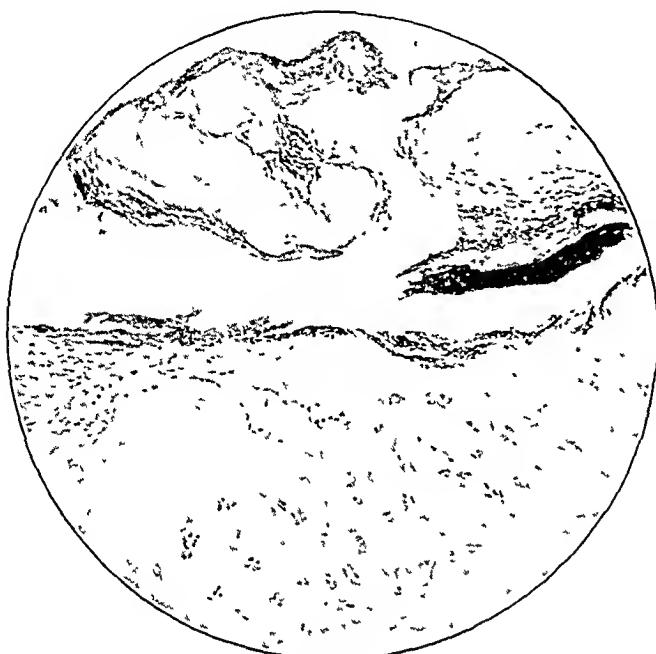


FIG. 4

The anatomical changes described account for the hazy clinical picture which renders difficult an early accurate diagnosis.

#### SYMPTOMATOLOGY, DIAGNOSIS, AND PROGNOSIS

Clinical detection of chondropathy is not easy. A careful history, with a detailed analysis of the mechanics of the etiology of the injury, is necessary. In contrast to injury to the meniscus, in cases of chondropathy, the patients usually state that trauma was inflicted directly by a blow in the region of the knee joint or by falling from a height. On the other hand, in cases of injury to the meniscus, it is almost always possible to determine the occurrence of the injury which was the result of an inward rotation of the femur with the tibia fixed. Consequently, the direct application of force would be more likely to indicate a chondropathic type of injury to the cartilage.

The patient usually states that after injury he noted a slight swelling, but he continued to work. Later, however, he observed instability and pain in the anterior portion of the knee joint, with a slight atrophy of the quadriceps. *An early symptom* which enabled us to make a diagnosis with absolute certainty in two cases consists of the following: The patient lies on his back, with legs spread apart and the muscles relaxed. The examiner seizes the patella between the thumb and the index finger and gives it a slight shove to the side. During this manoeuvre a *soft crepitus* is felt, which is absent in the sound limb.

*The symptom of unilateral crepitus* coincided in one case with a slight lateral displacement of the patella. The anatomical explanation of the symptom is found to be a slight callous thickening on the inner surface at the lower part of the patella.

*The second symptom* which aids in the differentiation of chondropathy from injury to the meniscus is the *sartorius symptom* (Chaklin's symptom), which is as follows: If the patient is made to lift the injured limb in an extended position, and if slight resistance is made, there will be noticed a contraction of the quadriceps and a compensatory tenseness of the sartorius. *This symptom is positive in injuries to the medial meniscus and negative in chondropathy.*

Injury to the cruciate ligaments is easily ruled out in the absence of the drawer symptom ("*tiroir de commode*").

It is necessary to rule out Konig's osteochondritis by taking antero-posterior and lateral roentgenograms, with the knee in the sharply flexed position.

Roentgenographic examination did not give us positive results at first in diagnosing injuries to the cartilage of the patella, but later, by comparing the roentgenographic evidence with the operative findings and by microscopic examination of sections, we were able to establish changes, as illustrated by the following cases.

**CASE 1. Patient M.** Trauma of two days' duration.

*Roentgenographic Examination:* The anteroposterior view showed an oblique crevice on the lateral border of the patella, with separation of this portion of the patella from the main mass. The lateral view was negative.

*Operation:* Operation revealed a defect in the cartilage, two by three centimeters. The cartilage was torn off in the form of a *free body* located in the lateral bursa of the synovial membrane. The knee had the appearance of recent synovitis.

**CASE 2. Patient Z.** Injury of over a year's duration.

*Roentgenographic Examination:* The roentgenograms revealed a well-defined contour and barely discernible rarefaction in the lower quarter of the patella.

*Operation:* Operation disclosed destructive changes in the cartilage of the lower portion of the patella and on the lateral femoral condyle. The changes did not invade the bone.

**CASE 3. Patient N.** Trauma of one and one-half months' duration.

*Roentgenographic Examination:* Roentgenograms showed a crevice extending for twelve millimeters at the lower medial border of the patella, with thin internal platelets separated from the main mass.

*Operation:* Operation revealed sloughed-off cartilage in localized portions at the lower lateral margin of the patella. The synovial membrane in the region of the medial bursa was slightly torn. The knee had the appearance of slight synovitis.

**CASE 4. Patient P.** Trauma of thirteen months' duration.

*Roentgenographic Examination:* The anteroposterior view, with insufflation of air, showed a well-defined meniscus, with no changes. A study of the lateral view up to the time of operation revealed nothing pathological. Analysis of the same view after operation disclosed a clear inner line cutting across the patella, adjacent to the center where there was slight unevenness and an ill-defined structure.

*Operation:* At operation, adjacent to the center of the medial surface of the patella, there were observed a deeply penetrating crack in the cartilage and a slight groove.

TABLE I  
DIFFERENTIAL DIAGNOSIS

Diagnostic Factors	Chondropathy	Injury to Meniscus	Injury to Cruciate Ligaments	Injury to Plica Alaris	Osteochondritis Dissecans (König)
Mechanism of Injury	Direct injury to the joint				Indeterminate; not always trauma
Pain	Indefinite in anterior portion of joint, frequently at lower border of patella	Along medial aspect of tibia	Frequently absent in chronic period	Indefinite in antero-medial portion of joint	
Chaklin's Symptom	Negative	Positive	Negative	Negative	
Soft Crepitus	Positive	Negative	Negative	Negative	
"Blockade" Symptom	Frequently negative; positive in presence of free body	Positive	Intermittent	Positive in presence of free body	
Drawer Symptom	Negative	Negative	Positive	Negative	
Hemarthrosis	Present or absent	Present or absent	Present in acute period	Present or absent	
Limitation of Function	Slight, due to synovitis	Intermittent	Persistent	Intermittent	Present in the last stages
Röntgenographic Findings	In lower area of patella (lateral view), barely discernible exfoliation of inner layer of cortex or unequal delineation; changes not always evident	Negative	Frequently negative; positive on loss of eminencia intercondyloidea	Negative	Specific changes

### DISCUSSION

From a careful analysis of the roentgenograms and by a special study of the lower medial border (lateral view) of the patella or of the lateral margin (anteroposterior view), in certain cases it is possible to establish the fact that slight changes have taken place, which, in conjunction with the clinical data, may aid in the diagnosis of obscure injuries to the knee joint.

It is characteristic that in the first stage of chondropathy there is very slight pain; this is explained by the fact that the cartilage does not show a pain syndrome even in the presence of inflammatory or degenerative changes. An analogous case is that of the rib cartilages, where pain is felt only in those cases in which the periosteum is involved and when ossification has set in. The absence of pain does not prevent the patient from working, but the degenerative processes continue to develop.

To simplify the differential diagnosis, the author has prepared the outline shown in Table I.

The "nipping", "jamming", or "blockade" symptom appears only in those cases in which the joint contains a foreign body. This occurs usually in the more advanced stages of the disease. The "blockade" symptom in such cases then closely simulates injury to the meniscus, but the absence of *Chaklin's symptom*, other things being equal, argues in favor of chondropathy and against an injured meniscus. The entire course of the disease is of a prolonged chronic character. Under the all-embracing diagnosis of "traumatic arthritis", the patient runs the gamut of physiotherapeutic treatments, without noticeable improvement, or with only temporary subjective improvement.

Because of the imperfect cartilage regeneration described, full recovery is usually not attained without operation. The joint remains inefficient, impairing the working capacity of the patient. Later there develops the picture of chronic synovitis or arthritis deformans.

### TREATMENT

For the most effective treatment, it is important that an extremely early diagnosis of chondropathy be made. There is no need for a lengthy postponement of the operation or for an unproductive expenditure of time in administering conservative treatment. In the less severe cases not involving functional derangement, temporary rest and the local application of heat are indicated. However, if the pain stubbornly persists, if slight restriction to movement is noted, or if synovitis develops, operation is indicated. The procedure which the author employs is as follows:

1. Spinal anaesthesia, using one and six-tenths milliliters of a 5-per-cent. solution of novocain.
2. Careful preparation of the skin; extreme attention to asepsis.
3. Payr's medial incision.
4. Opening of the synovial membrane and a careful examination of the joint, including the meniscus, the cruciate ligaments, the plica alaris, and the femoral condyle. The medial surface is then exposed and, if

changes such as cracks, grooves, roughness, etc., are found, the patella is turned over with a sharp hook.

5. Partial resection of cartilage. If confronted by limited surface changes in the cartilage (usually at the lower portion of the patella), a partial resection of the cartilage is carried out with a sharp knife; the border and under surface are smoothed down, and the defect is fully exposed. In the presence of changes on the femoral condyle only, partial resection of the cartilage without exposing the defect is carried out.

6. Total resection of cartilage. If confronted by very deep cracks, or by appreciable destruction of the cartilage as a result of chronic synovitis, a total resection of the entire cartilage surface down to the bone base is done. The surface is smoothed with a file and covered by fascia with a pedicle taken close by. The wound is closed by sutures of catgut or of thin silk.

7. Synovectomy is done in the presence of chronic exudation and villous growths on the synovial membrane resulting from chronic synovitis.

8. Closed suture of the synovia, fibrous capsule, and skin.

9. No fixation. The leg is kept flexed at a sharp angle for from four to five days. Early active movements are permitted in from two to three days, with massage of the femoral condyles. On the tenth day — or sooner in cases of only partial resection — the patient is allowed to begin to walk, first with the aid of crutches and later with a cane.

#### SUMMARY AND CONCLUSIONS

Out of a total of 159 cases involving operations on the knee joint, we have operated in thirty-eight cases in which there was injury to the cartilage of the patella. Of these thirty-eight cases, the results in twelve (32 per cent.) may be classified as being exceptionally good; in seventeen (45 per cent.), as good; in seven (18 per cent.), as fair or satisfactory; while in two (5 per cent.), treatment has not been completed.

The best results are obtained from partial resection of the cartilage. The period of treatment, with the resultant inability to work, is reduced to one or two months if functional after-care is maintained. Full functional restoration, with disappearance of the symptoms, is attained in this time. Total resection of the cartilage, followed by plastic covering over with fascia, noticeably protracts the period of healing from two to five months, but it likewise gives good functional results. The type of operation to be preferred is determined by the nature and the extent of the anatomical changes.

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## DROP-FOOT

### END RESULTS OF A SERIES OF BONE-BLOCK OPERATIONS

BY HIRI E. BRANCH, M.D., DETROIT, MICHIGAN

Because of the specialized function of the foot in locomotion, drop-foot is a serious complication. Even today it remains a difficult deformity of which to obtain a permanent correction.

Before the turn of the century very few stabilizing operations had been performed, and drop-foot was in reality a "brace" foot. Since 1900, however, there have been a succession of operative procedures to eliminate the braces. A few of these procedures are now listed in order:

1. Astragalectomy: Originated by Whitman in 1901 for paralytic calcaneus deformities, but also used in drop-foot cases.
2. Tendon fixations: Described by Gallie in 1915 as a check to prevent dropping of the foot.
3. Triple stabilization: First performed by Hoke in January 1917 and description later published, in 1921.
4. Bone block: Described by Campbell in 1923.
5. Wedge stabilization: Described by Lambrinudi in 1927 as a method of correction and stabilizing deformed feet.

The author does not wish to discuss these procedures. Each one was greeted with enthusiasm, only to be given up for the next. Of course, there remain adherents to each method and, in their hands, good results are obtained.



FIG. 1

End result of bone-block operation for drop-foot. Recurrence of foot-drop, due to failure of fusion in the mid-foot, designated by the arrow.

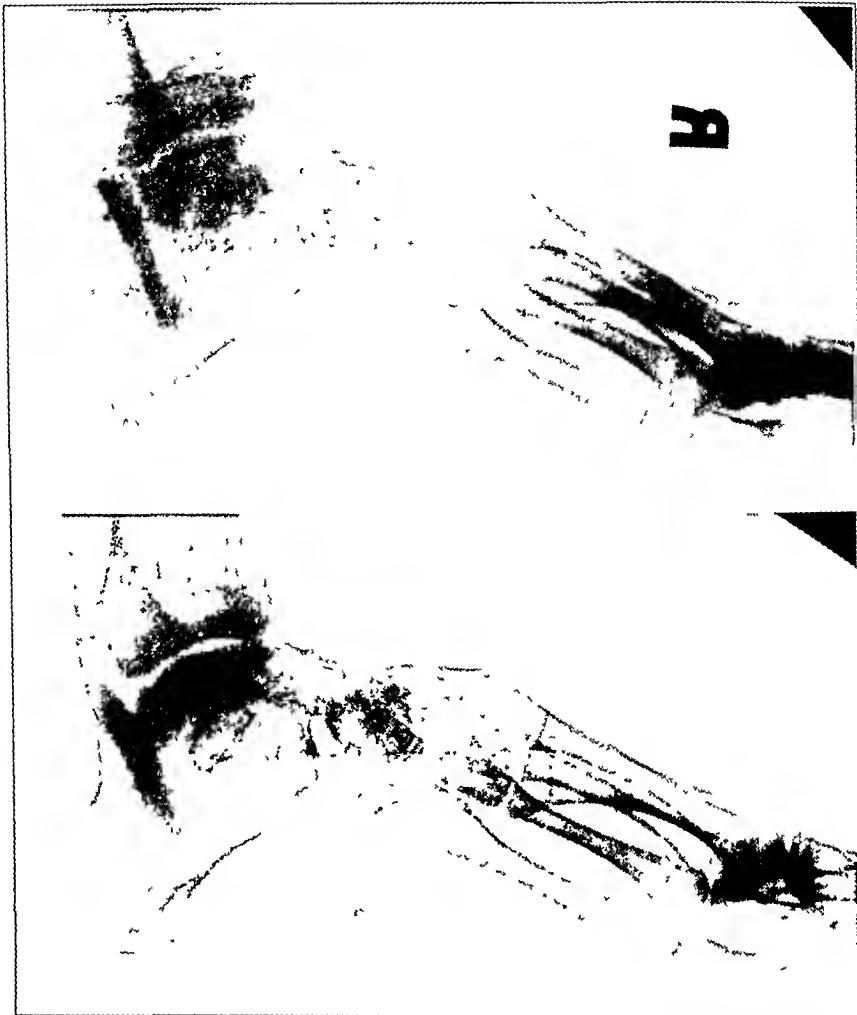


FIG. 2

Case 1. R. K.

*Upper:* October 24, 1934. Fibular bone-block peg. Foot stabilization satisfactory.

*Lower:* August 28, 1935. Bone block gradually being absorbed. Foot quite stiff in 125 degrees of equinus. Result only fair.

#### END RESULTS OF BONE-BLOCK OPERATION

Since the bone-block operation was described, sufficient time has elapsed so that the children upon whom this operation was performed have reached adult growth. Therefore an end-result study is in order.

The following brief résumés of the eighteen cases in which the bone-block operation or some modification of it was performed show these results: good, four cases; fair, four cases; failure, ten cases. End results in this deformity are hard to evaluate, for there is usually associated leg shortening or other disturbances so common in patients with anterior poliomyelitis. However, in these end results an attempt has been made to correlate the roentgenographic and clinical findings, with the subjective statements.

Measurement of the ankle motion in this series of cases was performed with the amount of drop-foot in mind. Thus, in making these measurements, a point immediately below the medial malleolus was used as the pivotal point, the zero point of the circle being on the anterior surface of the tibia. Then a line along the medial border of the tibia to the pivotal point and projected along the first metatarsal was used to give the angle and the amount of motion, which, in reality, represents the amount of drop-foot.

CASE 1. R. K., a girl, seventeen years old, had had anterior poliomyelitis at the age of three years.

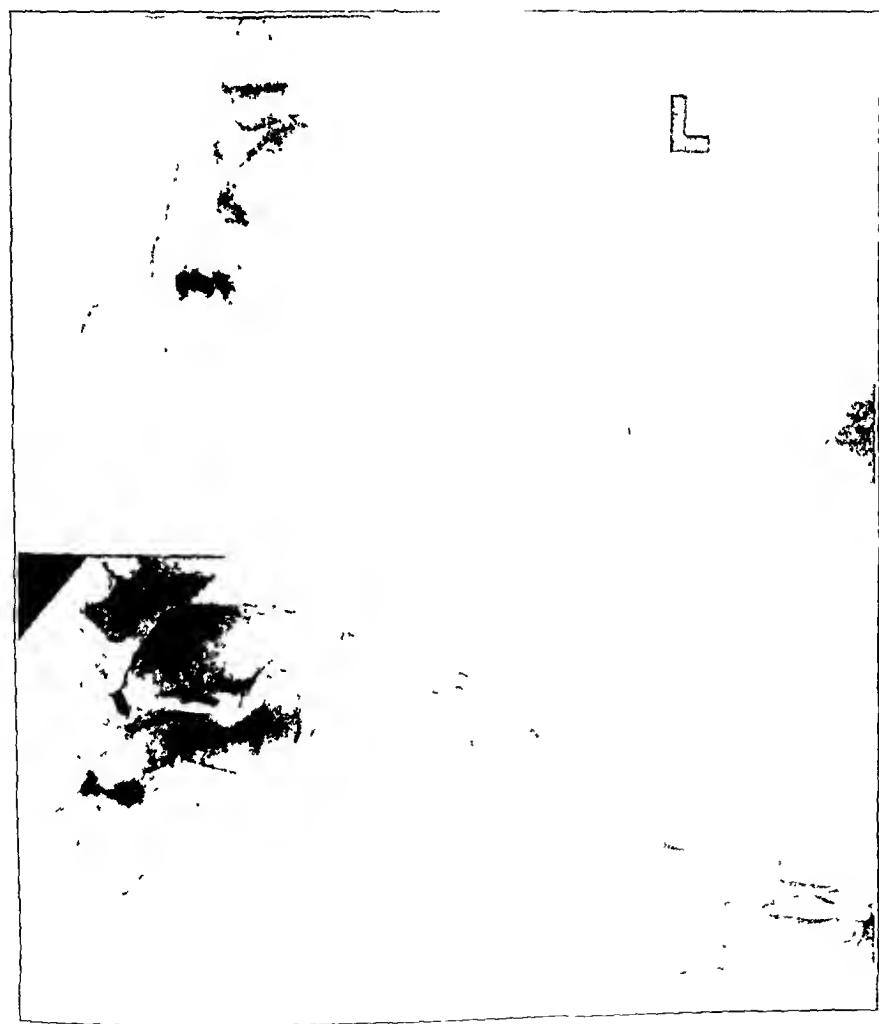


FIG. 3

Case 2. B. R.

Upper: May 10, 1932. Postoperative check-up shows good blocking of foot. No triple arthrodesis performed.

Lower: May 1, 1935. Bone block has held, but the forefoot has dropped. Result a failure. (Arthritic changes are seen to have occurred about the bone block.)

CASE 11. G. C., a boy, fifteen years old, had had anterior poliomyelitis at the age of two years.

*Operation:* Bone block and stabilization at the age of nine years.

*Result:* Good. The graft has proliferated; there is ankle motion of 15 degrees; and the graft blocks the foot well.

CASE 12. F. M., a girl, fifteen years old, had had anterior poliomyelitis at one year of age.

*Operation:* Bone block and stabilization at eight years of age.

*Result:* Good. The graft is five-eighths of an inch high, and the foot is held in good position.

CASE 13. E. C., a boy, sixteen years old, had had anterior poliomyelitis at one year of age.

*Operation:* Bone block, but no stabilization at the age of eight years.

*Result:* Failure. The forefoot drops, and there is no fusion of the astragalus and the navicular.

CASE 14. J. G., a boy, seventeen years old, had had anterior poliomyelitis at two years of age.

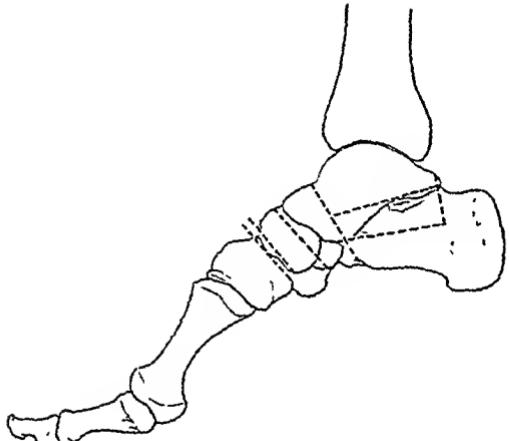


FIG. 6

Tracing of roentgenogram of a case of drop-foot. Dotted lines represent bone removed to correct the deformity and to allow fusion of subastragalar, astragalonavicular, and navicular-cuneiform joints.

*Operation:* Bone block and stabilization at eight years of age.

*Result:* Failure. The graft did not unite with the os calcis, and the foot drops.

CASE 15. B. C., a boy, twelve years old, had had anterior poliomyelitis at three years of age.

*Operation:* Bone block and stabilization at the age of seven years.

*Result:* Fair. There is motion from 120 to 145 degrees, and the forefoot drops 20 degrees further.

CASE 16. A. N., a boy, fifteen years old, had had anterior poliomyelitis at one year of age.

*Operation:* Bone block and stabilization at seven years of age.

*Result:* Failure. Motion over 130 degrees.

CASE 17. B. C., a girl, fifteen years old, had had anterior poliomyelitis at two years of age.

*Operation:* Bone block and stabilization at six years of age.

*Result:* Fair. The graft has united to the astragalus, not to the os calcis. Motion is blocked at about 125 degrees.

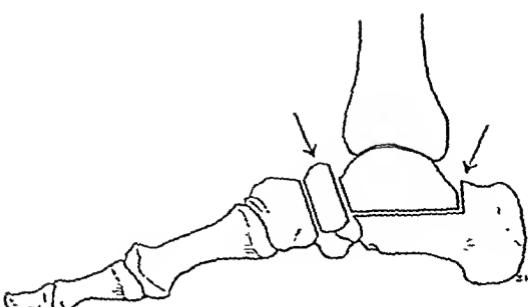


FIG. 7

Diagram of same foot, following removal of bone. Arrows point out anterior and posterior natural bone blocks to allow only limited ankle motion.

CASE 18. M. C., a girl, fourteen years old, had had anterior poliomyelitis at two years of age.

*Operation:* Bone block and stabilization at the age of six years.

*Result:* Good. There has been no recurrence of drop-foot.

#### COMMENT

From this study, it is evident that in many of these cases a very good result was obtained for a period of months, but the forefoot again dropped, due to the continued strain of walking, associated with the weight of the shoe on the foot.

This recurrence of drop-foot was due in some cases to failure of the operation and in others to dropping of the forefoot, even though the operative procedure maintained the os calcis in the corrected position. (See Figure 1.) The author believes that the failure of all the methods of correcting drop-foot which have been mentioned may be attributed to the same reasons. Even though the astragalectomy, stabilization, bone-block or tendon fixation may seem to be a success, sooner or later the forefoot may again become distorted in the astragalonavicular-cuneiform joints, as well as in the digital joints, thus allowing a recurrence of the foot-drop.

The age at which the operation is done is not of great importance. Two of the patients were operated upon at the age of six years: in one case a very good result was obtained; in the other, a fair result. Perhaps the reason for these favorable results was a generally smaller foot, due to the destruction of bone growth.

#### RECOMMENDATIONS

The author hesitates to present a destructive paper such as this with no constructive criticism. Figures 6 and 7 show the type of operation recommended by the author. He feels that the operation for correction of drop-foot should be deferred until the bones are well developed; then an extensive procedure should be carried out, which leaves only limited ankle motion, and fuses the astragalonavicular and navicular-cuneiform joints, to hold up the forefoot. The other alternatives are braces or artificial limbs.

The author wishes to thank the Orthopaedic Staff of the Children's Hospital of Michigan for permission to include their cases in this report.

# TUBERCULOSIS OF THE LONG BONES

## A REPORT OF SIX CASES

BY FRANK C. HODGES, M.D., ABILENE, TEXAS

*From the Willis C. Campbell Clinic, Memphis, Tennessee*

Tuberculosis of the long bones has been diagnosed in six patients at the Willis C. Campbell Clinic during the three-year period from 1935 to 1937 inclusive. It was the author's good fortune to study these cases and to participate in the diagnosis, which was established with difficulty in some of them. Tuberculosis of the long bones is infrequent, but the diagnosis is made easier by recalling its clinical manifestations from time to time. The condition must be suspected clinically before the diagnosis can be established by more extensive examinations and study. It is hoped that these case reports will help the reader to recall the clinical manifestations of osseous tuberculosis.

CASE 1. W. L. B., a female negro, nine months of age, was admitted to the John Gaston Hospital on November 16, 1934, because of multiple subcutaneous abscesses and fever of three weeks' duration.

*Physical examination:* There was painless enlargement of the lower end of the left tibia and of the right humerus. There were many abscesses in various stages of de-

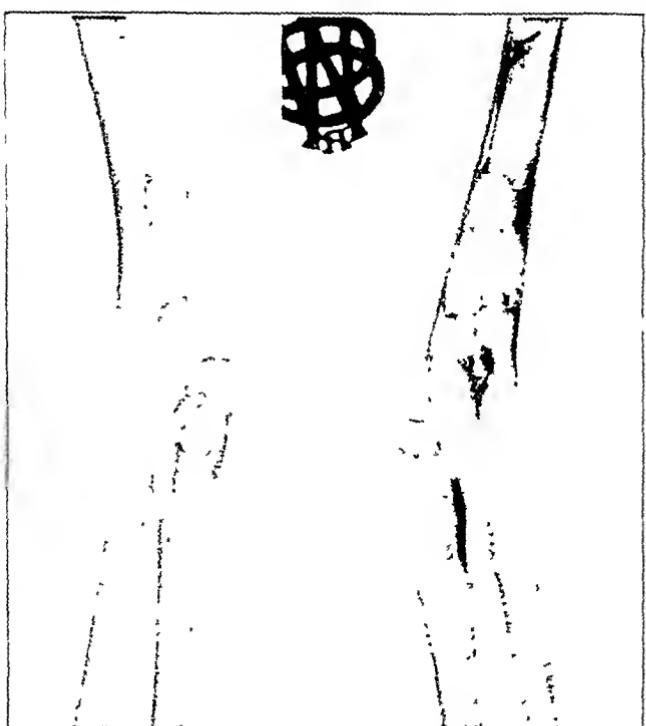


FIG. 1  
Case 1. W. L. B.

velopment, and sinuses were present over lesions of the left calcaneum and the right metacarpal. One abscess was aspirated, but no organisms grew on cultures.

*Diagnosis:* The first diagnosis was syphilis, which was based on a positive blood Wassermann and the roentgenographic findings (Figs. 1 and 2). After intensive antiluetic treatment for six months, without improvement, biopsy was done, and the tissue showed typical tuberculous changes. Tuberculous otitis media subsequently developed and ran a typical tuberculous course until the patient's death on October 11, 1936.

CASE 2. C. B. N.,  
a female negro, aged two

years, was admitted to the John Gaston Hospital on April 11, 1937, because of painless swelling of the right forearm and an abscess of the right thigh.

*Physical examination:* The general physical examination was negative except for the abscess on the thigh, the painless swelling of the right forearm, and a painless nodule in the left temporal bone. (See Figures 3 and 4.)

*Diagnosis:* Tuberculosis was suspected, and a biopsy was done on the nodule in the skull. The tissue showed tuberculosis.

*Operation:* A window, of sufficient length to permit removal of all granulation tissue, was made through the cortex of the radius. This material was positive for tuberculosis by guinea-pig inoculation.

**CASE 3.** J. W., a white male, aged twenty-eight years, was admitted to the John Gaston Hospital on December 13, 1936, because of fever, pain in the back, and a run-down condition of five months' duration.

*Physical examination:* The examination revealed a painless swelling of the eighth rib on the left side. Diffuse tenderness, pain, and muscle spasm were noted over the lumbar spine. Roentgenographic examination (Fig. 5) revealed multiple destructive lesions. Biopsy of the left eighth rib showed typical tuberculous changes. The patient's health declined steadily until his death on September 19, 1937.

**CASE 4.** M. L. G., a male negro, aged twenty-two years, was admitted to the John Gaston Hospital in April 1937, because of painless swelling of the right elbow and forearm with draining sinuses and a generally run-down condition.

*Physical examination:* The examination revealed painless swelling of the right elbow with draining sinuses. There was a hard, painless, fusiform enlargement of the ulna with a draining sinus (Fig. 6). The patient died on June 10, 1937. Autopsy revealed tuberculosis of the lungs, and tissue from the ulnar lesion showed typical tuberculous changes.

**CASE 5.** C. P., a male negro, aged eighteen years, was seen at the Willis C. Campbell Clinic in June 1937, because of a swollen right foot and a painless swelling of the left thigh.

*Physical examination:* The general examination revealed an old Pott's disease of the thoracic spine. The right foot was swollen, but not painful unless pressed upon. There was a draining sinus. There had been drainage from the left thigh. (See Figure 7.)

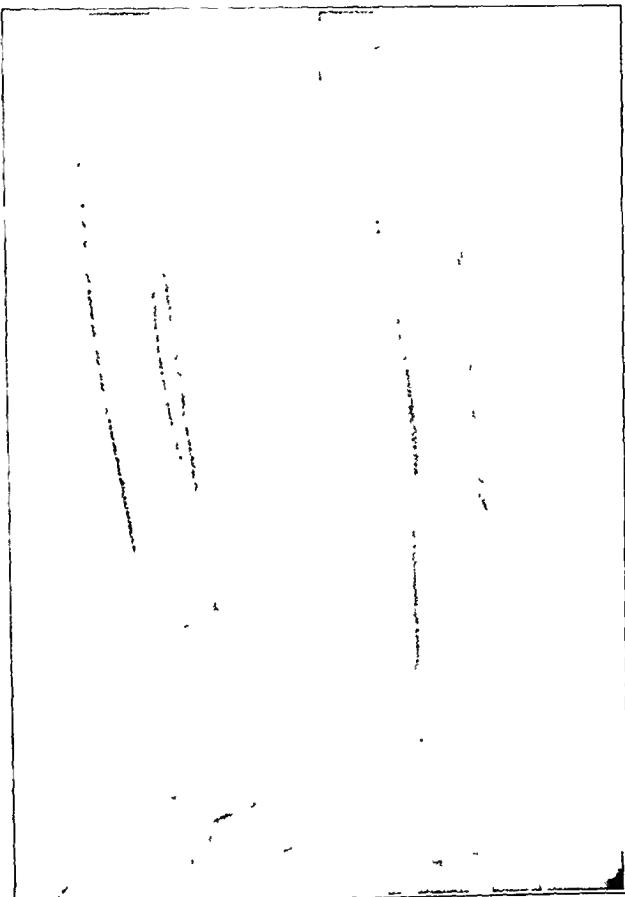


FIG. 2  
Case 1. W. L. B.



FIG. 4  
Case 2 C B N

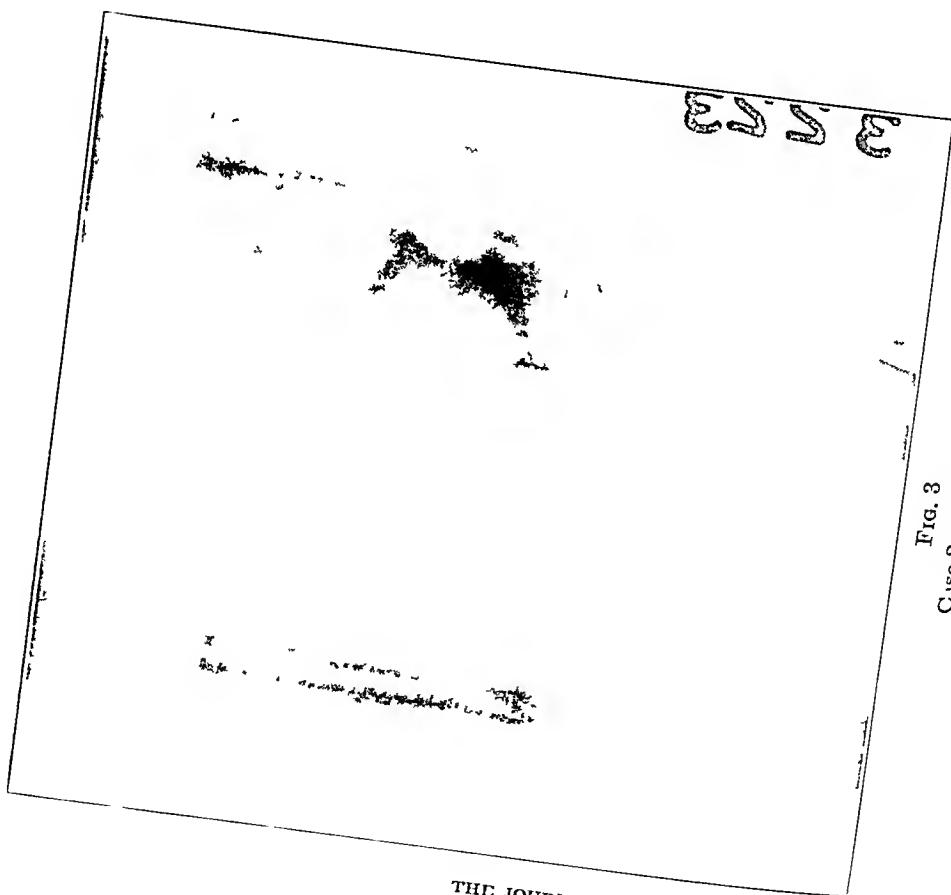


FIG. 3  
Case 2 C B, N

*Operation:* The right foot was amputated, and the left femur was opened and granulation tissue, which showed typical tuberculous changes, was removed.

CASE 6. R. T. C., a white male, aged thirty-seven years, was seen at the Willis C. Campbell Clinic on October 5, 1937, because of pain in the region of the left hip. One and one-half years before, a painless swelling had developed over the trochanter and had been drained. A sinus had persisted.

*Physical examination:* The general examination revealed nothing of importance, except painless induration about the left hip. (See Figure 8.)

*Operation:* The thickened bursa and indurated tissue were removed from over the trochanter. Through a second incision in the perineum, the lesion of the ischium was approached, and a sequestrum was removed. The tissue removed showed changes typical of tuberculosis.

The accepted opinion that tuberculosis is a rapidly fatal disease when accompanied by active lesions in the lungs and the bones is demonstrated in these cases.

It is interesting that lymphadenopathy was present in three cases and that biopsy in these demonstrated typical tuberculous lymphadenitis.

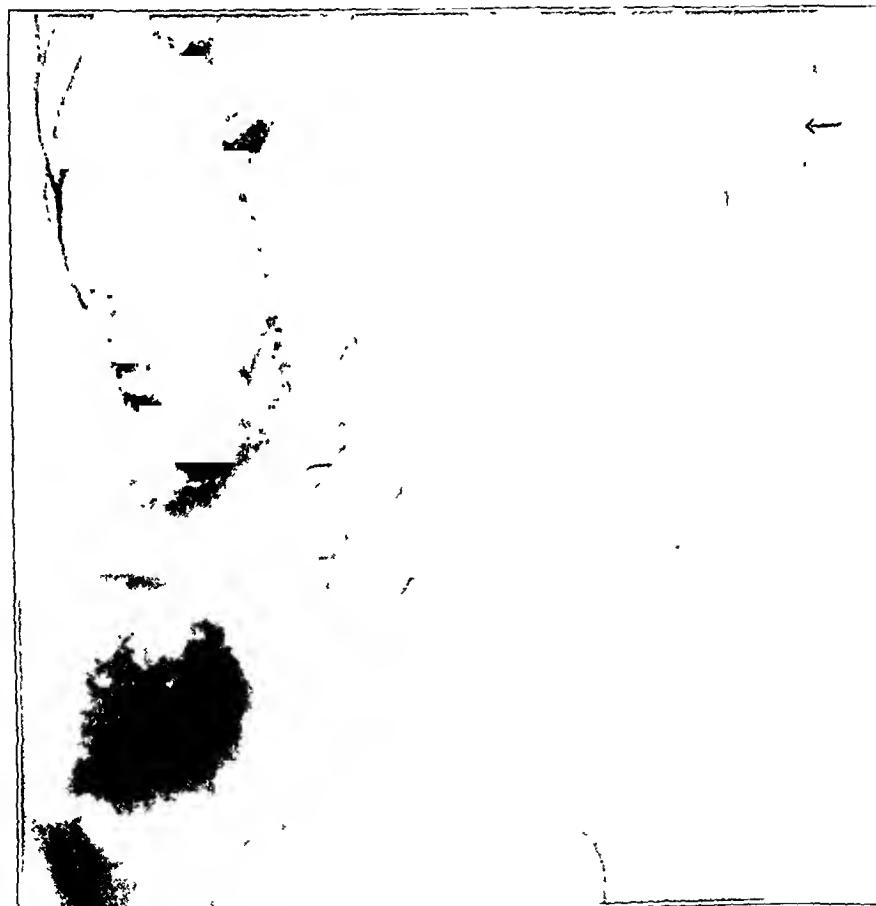


FIG. 5

Case 3. J. W. The arrow indicates the lesion in the eighth rib.

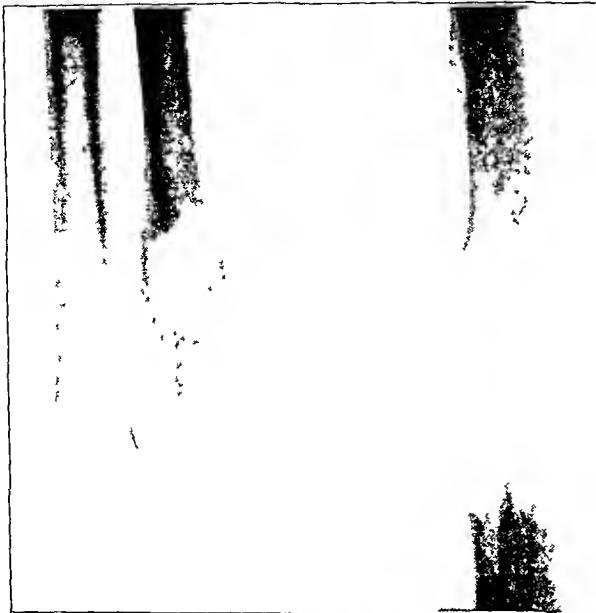


FIG. 6

Case 4. M. L. G.

A progressive tuberculous bone lesion induces osteoporosis, due to disuse and the increased vascularity which accompanies it.<sup>2</sup> If the tissue defense is adequate to produce a local fibrous reaction, the circulation may be diminished, with consequent osteosclerosis.<sup>1</sup> This type of reaction is seen in the more chronic types of tuberculous bone lesions. When such an osteosclerotic lesion is located in a cancellous bone, it stands out in marked contrast to the osteoporosis of the surrounding bone.

The various degrees of tissue resistance may be visualized roentgenographically. When resistance is great, there is lamellar osteosclerosis; when resistance is less, there is lamellar osteoporosis and possibly bone cysts.

Sequestration does occur in tuberculous osteomyelitis and, as always, the sequestrum appears in the roentgenogram as an area of increased density, which is in contrast to the decreased density of the surrounding bone. Sequestration is produced by sudden stoppage of the blood supply to the area by the inflammatory process.

The study of these cases emphasized the fact that certain clinical and pathological pictures may be brought about by different etiological factors. This has proved confusing in differential diagnosis. Possibly we have attributed certain changes too much to the etiological agent and not enough to the tissue reaction to that agent. It has been said that tubercu-

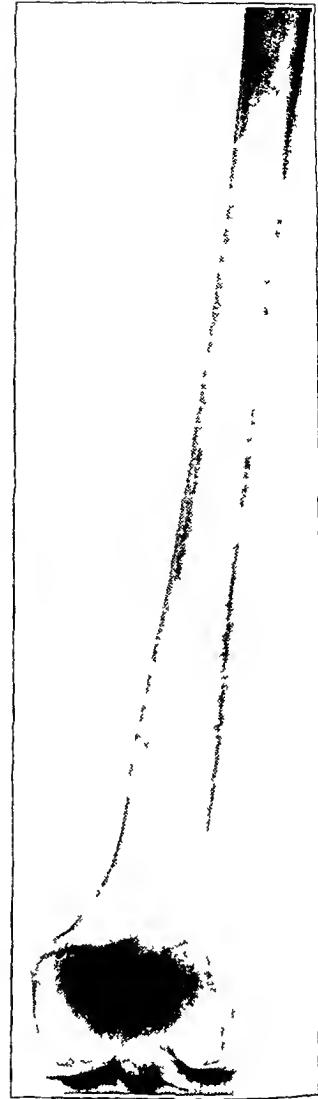


FIG. 7

Case 5. C. P.



FIG. 8

Case 6. R. T. C.

lous lesions behave in a manner corresponding to the structure involved. A tissue may react in a similar manner to similar stimuli even though they are produced by different etiological agents. With this in mind, one should proceed carefully in differential diagnosis and, as has been urged by others, a positive diagnosis, and not a presumptive one, should be established. In obscure bone lesions, such as may be produced by tuberculosis, biopsy and guinea-pig inoculation should always be resorted to.

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# VOLKMANN'S CONTRACTURE AS A COMPLICATION OF FRACTURES OF THE FOREARM AND ELBOW

BY J. NEILL GARBER, M.D., MED.SC.D., GASTONIA, NORTH CAROLINA

*Formerly Visiting Fellow in Orthopaedic Surgery, the Hospital for the Ruptured and Crippled, New York City*

*From the Clinics of the Royal Infirmary, Manchester, England, and the Hospital for the Ruptured and Crippled, New York City*

Previous literature has centered around Volkmann's contracture as a complication of elbow fractures. This condition may also follow forearm fractures, and the author believes that these fractures figure more prominently as a cause of this paralysis than is generally thought.

In the few available reports of numerous cases of ischaemic contracture, resulting from injuries to the upper and lower extremities, the incidence of forearm fractures was approximately 34 per cent. In reports of contractures after injuries to the upper extremity alone, the incidence ranged from 15 to 30 per cent. These cases are in the minority as compared to those resulting from elbow fractures, yet the writer feels that they demand more attention than they have received.

Recent literature dealing with circulatory changes following ligation of the great vessels and with the physiology of capillary circulation has been reviewed in an effort to clarify the contradictory aspects of present-day theories on the etiology of ischaemic contracture.

The purposes of this paper are: (1) to stress the importance of Volkmann's contracture as a complication of forearm fractures; (2) to suggest a classification of circulatory disturbances which may follow the treatment of these fractures; and (3) to discuss theories of the mechanism by which the contracture may occur.

The author has studied two groups of cases in an attempt to obtain additional data on the etiology of the disease.

The first group includes eighty consecutive cases of fresh fractures of the forearm, which were treated and followed in the Fracture Clinic of the Royal Infirmary, Manchester, England, until either a normal or a maximum functional result had been obtained. Particular attention has been paid to these points: (1) the presence of circulatory impairment before or after treatment of the fractures; (2) the development of temporary or permanent contractures of the fingers; (3) a possible relationship between the fracture level and the appearance of vascular or muscular changes; and (4) the frequency of nerve damage.

The second group includes eight cases of Volkmann's contracture following forearm fractures, which have been found in the records of the Royal Infirmary and the Ancoats Hospital, Manchester, England. Seven of these patients were between six and twelve years of age, and the remaining one was an adult of thirty-five years. An additional case of recent occurrence (a child, aged nine) has also been included. In this

second group, specimens of diseased tissue have been removed and studied microscopically whenever possible.

#### SERIES I—EIGHTY CASES OF FRESH FRACTURES OF THE FOREARM

These patients varied in age from two to eighteen years, and the fractures occurred at all levels of one or of both bones. Fractures involving the wrist and elbow joints have been excluded.

Seventy patients presented deformities which required manipulative correction under anaesthesia. In ten cases, fixation in plaster alone was sufficient. Forty-four patients received treatment within four hours after injury, and in all but one of these cases manipulation under anaesthesia was required. Thirty-four patients were treated after intervals of from twelve hours to five days; manipulation was required in twenty-six of these cases. The two remaining patients were treated two weeks after the injury, and in only one case was manipulation required.

The usual pain and discomfort were present in these cases, but signs of grave muscular or vascular disturbances were not seen in any prior to treatment.

In a collective review of these eighty cases (in none of which ischaemic contracture developed), the author has divided the circulatory and muscular disturbances, which are occasionally seen after manipulation and fixation, or fixation alone, into two classes: Class A, simple swelling of the fingers; and Class B, swelling of the fingers with transitory contracture.

Class A is characterized by: (1) marked swelling of the fingers; (2) brisk and pink nail-bed circulation; (3) no spontaneous pain in the forearm or hand; (4) no limitation of or pain on extension of the fingers; and (5) the absence of any nerve injury.

This type is probably due to simple plaster or splint compression, and is relieved almost immediately by bivalving the plaster or by loosening the splints.

Eighteen of the eighty patients presented this type of swelling, and each case progressed through an uneventful convalescence to a normal end result after the swelling had disappeared. The records did not state the type of plaster (padded or non-padded) used in every case.

There seemed to be no relationship between the development of the simple swelling and the level of the fractures in the forearm.

The characteristics of Class B are: (1) swelling of the fingers; (2) brisk circulation in the nail-beds, the color of which may be normal or slightly cyanotic; (3) occasional slight pain over the middle third of the volar surface of the forearm, which persists for four or five days after treatment of the fracture; (4) fixed moderate flexion of the fingers with power of further voluntary flexion (however, passive or active attempts to straighten the fingers cause pain over the region of the musculotendinous junctions of the flexor muscles in the forearm, most marked during the three or four days following treatment and disappearing within three weeks); and (5) no nerve injury.

## INCIDENCE OF CLASS A COMPLICATIONS

Level of Fracture of Forearm	CLASS A	
Upper $\frac{2}{3}$		14 cases
Lower $\frac{1}{3}$	4 cases	

## INCIDENCE OF CLASS B COMPLICATIONS

Level of Fracture of Forearm	CLASS B	
Upper $\frac{2}{3}$	6 cases	
Lower $\frac{1}{3}$	4 cases	

FIG. 1  
Incidence of complications.

The circulatory disturbance of this type is somewhat more severe than that of Class A, yet it leaves no permanent damage, nor does it progress to a true Volkmann's contracture.

Ten of the eighty patients presented this complication.

Pain on finger extension is most pronounced on extension of the flexor digitorum profundus, which lies upon the fractured bones. It is possible that an extravasation of fluid occurs between the fibers in a localized area of the muscle belly, as a result of direct injury by bone fragments, simulating, but not as severe as, the picture of early ischaemic paralysis. Surrounding muscles are not involved, because the lesion is mild and localized. In the final analysis, no permanent deformity exists.

Does the fracture itself cause this pain on finger extension? The general rule of fractures applies here as elsewhere in that, when a fracture has been reduced and properly immobilized, there should be very little, if any, discomfort at the fracture site. Digits should be so left as to

allow free, painless motion. All fractures in this series of eighty were reduced with satisfactory position of the fragments, followed by immobilization in plaster. In the majority of cases (seventy) there was no forearm pain or pain on extension of the fingers. As the fractures in the eighty cases were similar in type, the writer feels that the fracture alone cannot be considered as the sole cause of transitory finger contracture.

In fifty of the eighty cases, the fractures were in the middle and upper thirds of the forearm bones, and, following treatment, Class-B complications were seen in six of these. Fourteen presented simple swelling (Class A).

In the remaining thirty cases, the fractures involved the lower third of the bones, and, after treatment, transitory contractures were present in four and simple swelling in four.

The incidence of Class-B complications is about the same, regardless of the level of the bones involved; that of Class A is seen to be considerably higher after fractures in the upper two-thirds than after fractures in the lower third. (See Figure 1.)

#### SERIES II—NINE CASES OF VOLKMANN'S CONTRACTURE AFTER FOREARM FRACTURES

The symptoms and signs of the cases in this group are much more severe than those described in Series I, yet disturbances of circulation form the basis for all.

The clinical picture in the early stages is characteristic. Usually after a relatively comfortable period of several hours following the treatment of the fracture, severe pain spontaneously occurs over the volar surface of the forearm near the musculotendinous junction of the flexor muscles. This pain becomes progressively more severe and is not relieved by sedatives or narcotics in the usual doses. The fingers are swollen and cyanotic, and all voluntary motion in them is lost. They are flexed, and attempts to straighten them increase the pain in the forearm. Subjectively, the hand and fingers are numb, yet they are sensitive and painful if touched. If untreated, the characteristic "claw of Volkmann" is the result.

From the records of the first eight cases, signs of ischaemic contracture were not present before the fractures were treated. In the ninth case, loss of voluntary motion in the fingers occurred almost immediately after injury, yet signs of circulatory disturbance did not appear until several hours after treatment.

In eight of the nine cases, the fractures occurred in the upper two-thirds of one or of both bones; in the remaining case, the record did not state the level involved.

The following case, the most severe of the nine cases, illustrates the development of the contracture.

F. L., a boy of nine, was seen at the Manchester Royal Infirmary on May 4, 1936, half an hour after the left forearm had been fractured in a fall. Marked tenderness was

present in the middle third, and there was volar angulation of the fragments (Fig. 2-A).

Reduction was done under anaesthesia, and a non-padded plaster was applied, immobilizing the elbow and wrist joints. A roentgenogram showed satisfactory alignment, but not end-to-end approximation of the fragments.

Within the next forty-eight hours, the fingers had become swollen, yet voluntary motion was present and the nerves were normal. On the morning of the third day, swelling had increased, pain had appeared spontaneously in the forearm, and the fingers and hand were cyanotic. There was no voluntary motion in the fingers, and they were held in flexion. At this time, the plaster was removed under anaesthesia, and within five minutes the cyanosis of the hand had disappeared. There was no evidence of plaster compression. A hard mass was palpable in the soft tissues of the volar surface immediately over the fracture site. Full passive extension of the fingers was possible under anaesthesia. Even though the circulation had improved, the immobility of the fingers and the pain persisted after recovery from anaesthesia.

Approximately twenty-four hours after the first signs of ischaemia had appeared, an exploratory operation on the forearm was done by Mr. H. O. Clarke.

On division of the deep fascia over the volar surface of the forearm, the muscle bellies distal to the fracture site were bulging, apparently under considerable tension. The portions of the muscle bellies (*flexor pollicis longus*, *flexor digitorum profundus*, *flexor digitorum sublimis*, and *pronator quadratus*) below the fracture level were slate gray in color, did not bleed, and did not respond to electrical stimulation. The line dividing the normal from the affected muscle was clear cut.

The muscles were dissected from each other, and the deep fascia was split. The more superficial bellies became more nearly normal in color, but at no time did the por-

tions below the fracture level respond to stimulation.

Complete exposure of the median nerve revealed no palpable or visible abnormality, yet it was silent on faradic stimulation.

The appearance of the brachial artery and its branches, exposed at the bifurcation, was most striking. The three vessels (brachial, radial, and ulnar) were dead white in color and were constricted to the size of a match stick. Pulsations in them were almost imperceptible.

The ends of the distal fragments were displaced volarward, but were not pressing upon any vessels or nerves. A portion of muscle was removed for study (Fig. 2-B) and, after all structures under tension had been freed, the wound was closed.

The "claw of Volkmann" became well established during the next four weeks. At the end of eight weeks, roentgenographic examination showed complete bony union of the fractures. After three months (Fig. 2-C), there was a severe contracture with hypcreaesthesia over the distribution of the median nerve in the hand, and tenderness over the operative scar, which lay directly over the course of the nerve in the forearm.

Because of the severe and persistent neuritis an operation to explore the nerve was done nine months after the onset of the contracture by Mr. Harry Platt.

The median nerve was found to be embedded

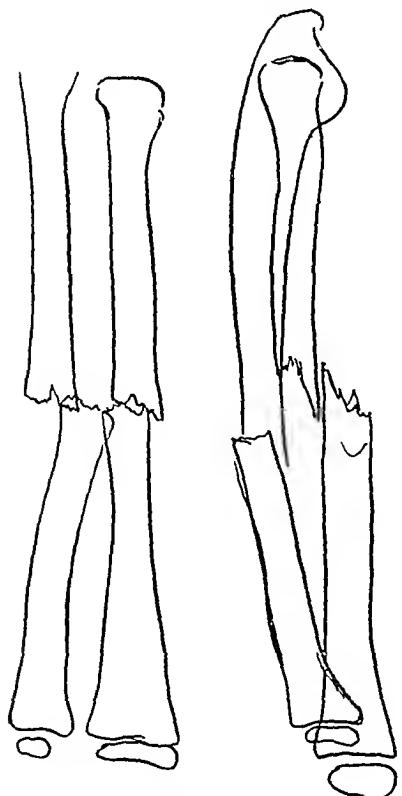


FIG. 2-A

Diagram of roentgenogram of Case F. L.

firmly in the fibrous-tissue mass, which had replaced the greater portion of the group of flexor muscles. Faradic stimulation produced no contracture of the hand muscles. The nerve was dissected free of its fibrous surroundings and was covered by a sheet of fascia lata. A slight wound infection unfortunately followed the operation.

The last note on the case, June 11, 1937 (approximately six months after neurolysis), is as follows: "Partial median anaesthesia, thenar palsy. Flexion contracture of the fingers as before."

In one of the other cases, the onset of symptoms occurred one week after the treatment of the fracture. Fibrosis of the muscles in this case was of mild degree, yet it caused a complete blocking of the ulnar nerve. Neurolysis was done approximately three weeks after the injury, and three months later the arm and hand were normal, except for a small dense mass of fibrous tissue beneath the operative scar. This had formed in the muscle tissue as part of the ischaemic process and was present before operation.

In another case, an exploratory operation of the forearm was done three months after the development of the contracture. In the upper third of the forearm, the muscles were normal, but at the musculotendinous junction in the lower third there was an area of fibrosis involving the flexors of the thumb and fingers. This fibrous tissue had a yellowish appearance and lay immediately beneath a trophic ulcer in the skin.

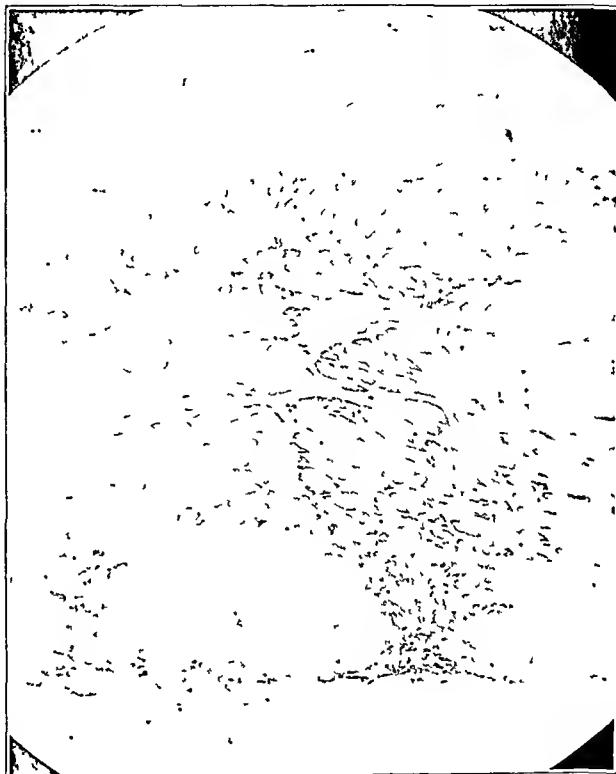


FIG. 2-B

Photomicrograph of muscle removed from Patient F. L. at operation. This section shows little other than a slight degree of extravasation of blood and beginning degeneration of a few muscle fibers



FIG. 2-C  
Case F. L., showing the typical "claw of Volkmann".

In all cases, excepting the one mentioned, the onset of symptoms occurred rather soon after the fractures had been treated. Plaster casts were applied in six cases, and splints were used in the remaining three.

#### GENERAL FEATURES OF VOLKMANN'S CONTRACTURE

The earliest signs of the contracture usually appear within from four to six hours after an injury or after treatment of a fracture. A few cases, however, have been reported in which the onset occurred after forty-eight hours, and others after one week.

Many authors have described the color of the hand as cyanotic in the early stages, while others have pointed out that it may be pallid or blanched. The former suggests a "venous", and the latter an "arterial" type of onset, the differentiation being based solely upon the appearance of the hand during the first few hours. Pain in the forearm and hand and immobility of the fingers are present in both instances. After forty-eight hours, the acute pain and the signs of severe circulatory disturbance commence to subside.

The clinical picture of the fixed deformity needs no further description. The cause of the flexion contracture of the fingers and the poor voluntary motion in them is apparent from the fibrosis in and the retraction of the bellies of the flexor muscles.

Trophic ulcers may appear in the skin overlying the indurated muscles and also in the skin of the hand and fingers. Other trophic changes are the thinned and glistening appearance of the skin, the cyanotic mottling, the coolness to touch, and the degeneration of the nails. When the plaster or splints are removed during the early stages, vesicles or ulcers may be present on the forearm, and pressure from the apparatus is often thought to have been the cause. These ulcers, however, overlie the indurated areas in muscle, and may constitute superficial evidence of the grave circulatory damage which has occurred beneath them.

#### PATHOLOGICAL CHANGES IN MUSCLE

At the onset, the muscles are plum-colored and are extremely indurated and tense within their fascial sheaths. There is marked extravasation of blood and serum about the fibers, yet a true hematoma does not form. The process progresses rapidly, and within forty-eight hours great numbers of polymorphonuclear leukocytes accumulate about the fibers, adding an inflammatory aspect to the picture. Even at this early stage, many of the muscle fibers are clearly necrotic, showing fragmentation and disappearance of nuclei.

Organization of the exudate begins within four or five days and is well established within ten days. The fibrous change varies,—sometimes the muscle belly has been shortened only, and sometimes it has been reduced to a fibrous cord prolonging the tendon. The number of destroyed muscle fibers varies with the severity of the original lesion; if it has been mild, many normal functioning fibers persist, and, if severe, usually all of the fibers are replaced by connective tissue.

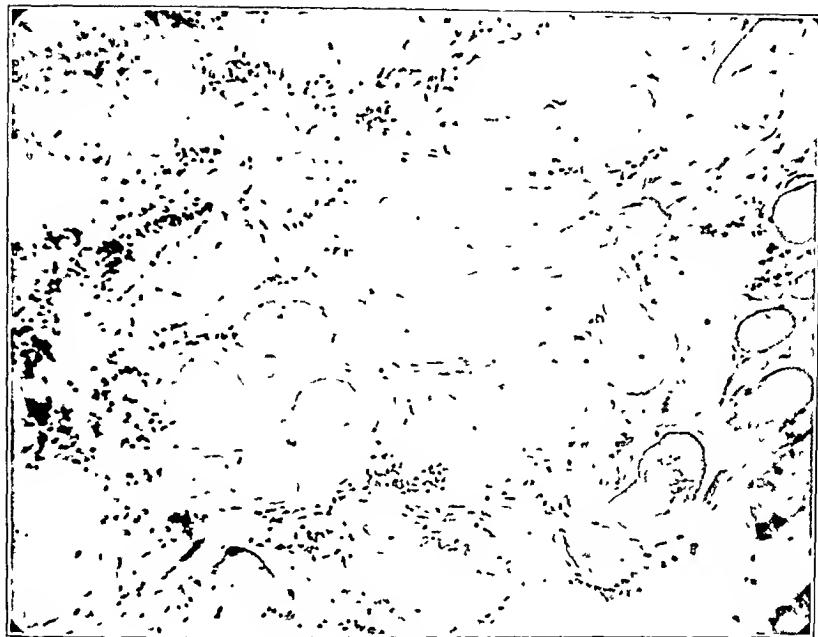


FIG 3

High-power photomicrograph of section of muscle from a case of Volkmann's contracture of three months' duration, following a supracondylar fracture of the humerus. Note the extensive fibrosis and the muscle fibers in the meshwork of connective tissue. A few of the fibers are in the process of being replaced by fibrous tissue.

Histologically, the connective tissue forms in bundles and bands, which ramify throughout the muscle belly and replace the dead muscle fibers. There is formed a meshwork of connective tissue, in the open spaces of which are found islands of living muscle tissue. The difference in proportion of the living to the dead fibers accounts to some extent for the degree of severity of the fixed deformity. The persistence of some living fibers explains why the muscle may regain some of its function.

At certain points, the connective-tissue bands are very dense and without a trace of cells; at other points in contact with necrosing muscle, the fibrous tissue has a fibrillar aspect, and in these sites macrophages are seen. Besides young fibroblasts and histiocytes, there are mononuclear cells and cells resembling giant cells. These are closely applied to the outlines of the cells and occasionally penetrate them. (See Figure 3.)

#### NERVE LESIONS ASSOCIATED WITH VOLKMANN'S CONTRACTURE

In the mild cases, the established deformity may be due to muscle retraction alone. In the more severe ones, it is due to a combination of muscle retraction of the forearm flexors and a flaccid paralysis of the hand muscles, the latter resulting from peripheral-nerve involvement.

The early subjective symptoms of numbness, severe pain, and hyperesthesia of the hand and arm may be ascribed to compression of the nerves between indurated muscle bellies, in addition to the fact that the amount of blood to the entire part has been diminished.

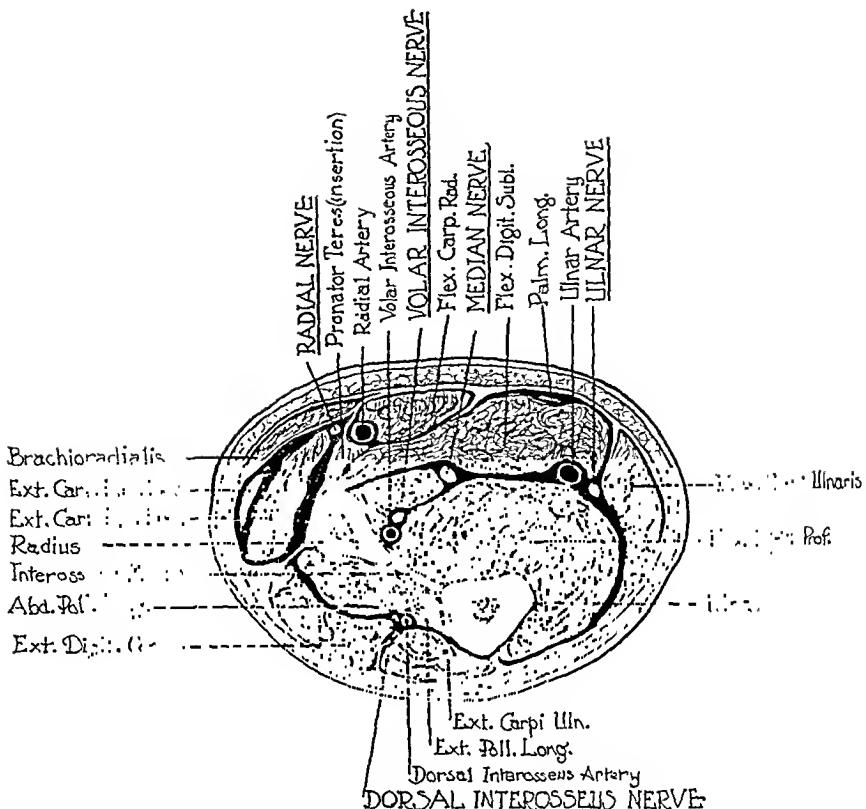


FIG. 4

Cross-section of the forearm at the level of the middle third. Note the muscles surrounding the median nerve. (From Cunningham's *Text-Book of Anatomy*, by courtesy of the Oxford University Press.)

As the exudate within and between the fascial sheaths becomes organized, the nerves are caught in the fibrotic process and are virtually strangulated. This so-called secondary involvement of the nerve trunks is permanent and severe. The nerve trunk may be compressed over varying distances and, when dissected free from its adherent fibrous surroundings, it is decreased in size and sclerotic.

The median nerve is most frequently and severely involved, whether the contracture follows an elbow or a forearm fracture. The ulnar nerve may be affected as well, but the severity of involvement is less than that seen in the median nerve. Lesions of the radial nerve are rare and are seen only in the early stages.

Characteristic of uncomplicated Volkmann's contracture is the fact that when the end point in the fibrotic process has been reached the muscles retain some degree of contractility. This indicates that the nerve supply to the flexor muscles is intact.

At the elbow, the median nerve is quite vulnerable to direct injury from bone fragments, while in the forearm, it is the one most securely protected from such an injury. (See Figure 4.)

With the exception of the nerve to the pronator teres, which some-

times arises above the elbow joint, the median nerve gives off no branches to the forearm flexors above the joint level. The muscle branches arise near to but below the elbow joint. Because of this anatomical arrangement and because some function persists in the flexor muscles of the forearm, it is probable that the clinical picture of Volkmann's contracture cannot be simulated by direct injury to the median nerve from the bone fragments of a supracondylar fracture of the humerus.

In irritative nerve lesions (in which there is always an incomplete block to conduction) extensive fibrosis develops in the muscle bellies and joint capsules, resulting in severe contractures. Thus, the contracture of a nerve lesion closely simulates that of Volkmann's contracture, which is believed to be the result of a purely vascular lesion. There are certain points of distinction in the clinical pictures. In the classical Volkmann's contracture, the changes in the muscle bellies occur within a few days after the onset of symptoms. In a nerve lesion, the fibrotic changes take much longer to mature; also, the dense phlegmonous induration palpable in the flexor-muscle bellies, which is characteristic of Volkmann's contracture, is not seen in uncomplicated nerve lesions.

#### ANATOMICAL CONSIDERATIONS

It has been generally assumed that the comparative inextensibility of the aponeurotic compartments in the forearm and elbow explains why hemorrhage and effusion into such hermetically sealed spaces create an internal pressure sufficient to embarrass the circulation. It is undoubtedly true that incision of the fascial sheaths early in the course of ischaemic contracture has prevented the development of the deformity.

Middleton has emphasized the presence of a venous plexus at the bend of the elbow, with a diameter of about two centimeters. Pressure exerted upon this area can obstruct the venous return from almost all tissue on the volar surface of the forearm. This anatomical arrangement is of considerable importance in the consideration of elbow fractures. (See Figure 5.)

Two significant findings at operation in cases of impending ischaemia after elbow fractures are: (1) interference with blood supply due either to direct damage to or to spasm of the brachial artery; (2) the swollen and turgid muscle bellies in the upper part of the forearm.

In ordinary forearm fractures, direct injury either to the radial or to the ulnar arteries by bone fragments is unlikely, yet vasospasm may be encountered (Case F. L.). The direct evidence in favor of an acute venous block in this case is nil.

Regardless of whether the ischaemic contracture follows an elbow or a forearm fracture, the muscles most severely involved are the flexor digitorum profundus, the flexor pollicis longus, and the flexor digitorum sublimis. With the exception of one head of origin of the last-named muscle, all three arise from the surfaces of the forearm bones and interosseus membrane, and have no direct connection with the antecubital

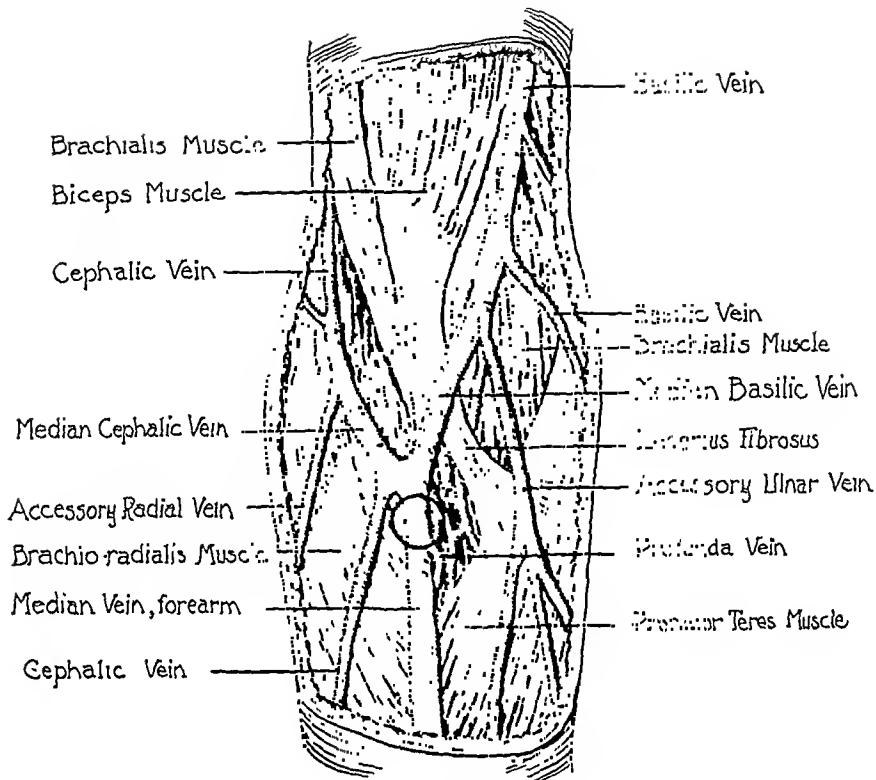


FIG. 5

Drawing showing the principal veins about the elbow. Pressure over the encircled region will block the venous drainage from a large area in the forearm. The deep median vein connects the median vein with the deep veins from the tissues of the volar surface at the middle of the bend of the elbow. (From Cunningham's *Text-Book of Anatomy*, by courtesy of the Oxford University Press.)

fossa. From the standpoint of possible expansion, these muscles are more limited than surrounding ones, because they are more intimately associated with the forearm bones, and because their bellies traverse relatively shorter distances in the forearm. Any change, then, which tends to increase the intramuscular and extramuscular tension in this area will make itself felt sooner and more severely in these muscle bellies, because they have less room for expansion.

#### PHYSIOLOGY

Within a few seconds after the complete arrest of the circulation to an extremity, there is a slight but distinct paling of the skin, which appears gradually as the blood drains out of minute vessels into veins. The part soon becomes cyanotic, because of dilatation of minute vessels in the affected tissues. This dilatation, or reactive hyperaemia, depends upon the vasodilator action of metabolites accumulating in tissues deprived of blood and is independent of both central and local nerve influences. With occlusion of the main artery alone to the extremity, slight cyanosis develops, but it never approaches the full discolouration of arrested blood flow.

Death of muscle occurs in from six to eight hours after the muscle has been deprived of blood. The final result of this is fibrosis.

When pressure sufficient to occlude venous return is applied above the elbow, a biphasic increase in limb volume occurs. During the first phase, the volume of the hand increases rapidly for from fifteen to twenty seconds, due to collection of blood in the venules and capillaries. This increase ends when venous pressure becomes equal to the pressure causing the obstruction. The capillaries are able to contract against pressures of from fifty to sixty millimeters of mercury, but when the venous pressure rises to ninety or 100 millimeters of mercury, petechial hemorrhages may occur. The second phase is due to stretching of the vascular bed and to tissue oedema (de Takats, Hieck, and Coulter).

The inability to produce complete peripheral vasodilatation by any of the known vasodilating methods or by complete removal of the sympathetic fibers to an extremity further suggests that the autonomic system does not completely control the dilatability of the peripheral arterial system.

#### DISCUSSION OF THEORIES

At present there are two outstanding schools of thought on the etiology of ischaemic paralysis—those who favor arterial spasm or arterial injury as the primary cause, and those who support the theory of acute venous obstruction.

Brooks and Jepson have produced in muscles of dogs fibrotic lesions similar to those of Volkmann's contracture by impeding venous return from the muscles.

Later work by W. C. Wilson and Brooks, dealing with ligation of the main vessels in the extremities, has showed that ischaemic contracture occasionally occurs after occlusion of the large arteries alone. Contractures of this type, however, developed later and were attended by a less severe degree of inflammation than those attributed to venous obstruction.

Leriche and others have believed for some time that the effect on the vasomotor system produced by injury to the sympathetic fibers in the wall of the brachial artery is a greater factor in producing ischaemic paralysis than the actual mechanical interference with the blood supply to the muscles.

The "sympathetic theory" holds that an area of ischaemia occurs in the forearm muscles as the result of spasm or tearing of the brachial artery near the site of injury at the elbow. Tissues surrounding the ischaemic zone receive the blood of the capillaries by reflux and, as a result of the decline in pressure in vessels where circulation has been arrested, the inflow of blood causes capillary rupture or transudation of elements of the blood. In this way, the serosanguineous effusion occurs between muscle fibers and causes the muscle bundles to become swollen and tense.

Theories on etiology are chiefly concerned with vascular injuries in the elbow region; yet, as Scherb has stated, injury to or kinking of vessels by bone fragments in elbow fractures cannot explain the occurrence of the contracture when it follows forearm fractures.

Scherb advanced the theory that an overdeveloped volar interosseous artery may be present; and, if it were torn by bone fragments in the forearm, the resulting hematoma could be sufficiently large to produce the pressure which causes the contracture. Scherb, however, cites no cases illustrating this abnormality and the author has not found evidence elsewhere to substantiate this theory.

Upon the possibility that early ischaemic lesions after elbow fractures are due to arteriospasm, Leriche has advised either stripping or resection of a portion of the brachial artery to remove the sympathetic influences. Beneficial results after such a procedure are difficult to evaluate, because the artery could not be exposed without cutting the fascia in the ante-cubital space. Relief of the ischaemia might result from release of tension by exposure of this space.

The theory that ischaemic contracture occurs from arteriospasm alone is questionable. When the adventitia of any normal artery is touched, the vessel undergoes a localized constriction, which may persist for from two to eighteen hours or longer. Portions of the vessel above and below this segment retain their normal caliber as long as they remain untouched.

If vasospasm occurs at one level in the brachial artery from contusion by bone fragments, that spasm is not directly transmitted to other portions of the vessel or its branches, and the tissue requirements will be satisfied through collateral channels as long as they are not obstructed by other influences. Under normal circumstances, after ligation of the main artery to an extremity, much of the blood supply is restored within from three to ten minutes.

In the case described (F. L.), the radial and ulnar arteries were markedly constricted. It is possible that spasm of these vessels at the middle third of the forearm resulted from trauma by bone fragments, yet it seems more likely that spasm in the upper segments was caused by compression from the indurated muscle bellies.

Experimental work shows that contractures may result from arterial as well as from venous blockage, and, in man, it may be feasible to differentiate the onset of either type according to whether there is pallor or cyanosis of the hand.

In many cases of supracondylar fracture, the radial pulse has been absent for from thirty-six to forty-eight hours, yet ischaemic contracture has not developed. Furthermore, the signs of ischaemic contracture have been completely relieved by fasciotomy alone in some cases in which the condition of the brachial artery has not been investigated. The indication is, then, that arterial injury is not always the only factor in producing the ischaemic lesions.

The picture of Volkmann's contracture closely resembles that of complete arrest of circulation over a given period of time with involvement of both arterial and venous systems. It is probable that blockage of flow through one of the systems occurs either from direct injury to the vessels or from pressure of soft-tissue oedema at the onset of the disease, and that the system not directly affected at first soon becomes involved.

When venous return is obstructed early in the process, arterial blood may continue to enter the forearm nearly at the usual rate of flow. It is even possible that arterial pressure in the forearm increases by vasoconstriction, which may account in part for the vasospasm seen in some cases at operation. With less oxygen available per unit of volume during general asphyxia, an additional supply of blood is required to maintain an equilibrium in the tissues. Two forces are called into play: reflex vasoconstriction and local vasodilatation (Freeman, Shaw, and Snyder).

In forearm fractures the effusion probably follows direct injury to muscle bellies by bone fragments, and, as it progresses, the muscles swell within their sheaths. Rising pressure within the forearm gradually obstructs venous drainage, not only from the traumatized muscles, but also from the adjacent ones, and there is beginning anoxaemia of large areas of tissue.

In the cases of Volkmann's contracture following forearm fractures which the writer has studied, the hands have shown cyanosis, not pallor, at the onset of circulatory disturbances; therefore, it may be that venous obstruction was the primary causative factor.

#### TREATMENT

Complications of the Class-A and Class-B types may be relieved by bivalving the plaster or by loosening the splints.

If signs of ischaemia appear, the immobilizing apparatus should be removed at once and the arm should be elevated. Improvement in the color of the hand after these measures may mislead one to believe that there is nothing more to fear. If voluntary finger motion is still markedly restricted, and if severe pain persists for two hours after the removal of splints or plaster, immediate operation is indicated.

The operation should include: (1) opening of the aponeurotic sheaths of the flexor muscles of the forearm to release tension; (2) inspection of the median and ulnar nerves; (3) inspection of the brachial artery and its main branches. After all tension has been released and the nerves have been freed of compressing structures, the skin only is closed. A rubber drain may be placed in the wound for twenty-four hours. The operation should be done as soon as the diagnosis is evident, because good results after a delay of twenty-four hours are few.

#### CONCLUSIONS

1. The circulatory complications of forearm fractures may be di-

vided into three classes: A, simple swelling of the hand; B, transitory contracture of the fingers; and C, Volkmann's contracture.

2. Complications of the Class-A and Class-B types are amenable to conservative treatment.

3. Ischaemic contracture, occurring after elbow or forearm fractures, appears to be the result of an almost complete arrest of the circulation in the flexor muscles of the forearm.

4. If the permanent deformity of Volkmann's contracture is to be prevented, the operation of aponeurotomy must be done early after the appearance of the first signs of the disease.

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# OSTEOSARCOMA OF THE BONY PELVIS ASSOCIATED WITH CARCINOMA OF THE URINARY BLADDER\*

BY ROSEMARY SHOEMAKER, M.D., ROCHESTER, MINNESOTA  
*Fellow in Urology, The Mayo Foundation*

AND H. E. ROBERTSON, M.D., ROCHESTER, MINNESOTA

*From the Section on Pathological Anatomy, The Mayo Clinic*

The incidence of multiple primary neoplasms as given by different authors is between 1 per cent. and 4 per cent. in all cases of malignant tumor. The two primary neoplasms may occur in succession over a period of years or they may be coexistent. The primary neoplasms may occur in the same organ (as skin, intestinal tract, uterus, etc.) or they may involve different organs. The neoplasms may be of the same or of different types. The coexistence of carcinoma and sarcoma probably is the rarest of these combinations. The following case is of special interest, as one of the primary neoplasms was not recognized until after the death of the patient, although it probably was largely responsible for the fatal outcome.

## REPORT OF CASE

A white man, aged thirty-one years, was first seen at The Mayo Clinic on September 18, 1933. In 1922, he had had chronic osteomyelitis of the right tibia; this had healed after drainage had been instituted, and the disease had not caused any further trouble. His mother and a maternal uncle were both thought to have died of cancer. Otherwise, there was no previous illness or family history of importance. His present trouble had begun one year before he came to The Clinic, when he had noted a mild aching pain in the left hip. Six months later, this pain had involved the medial aspect of the upper part of the left thigh. Nine months after he had first noticed the pain, the patient had experienced some difficulty in defecation and had had a sensation as if there were a mass in the rectum. Ten days before he came to The Clinic, he had consulted a physician, who had made a rectal examination. This had revealed a fixed, hard mass in the pelvis. Roentgenographic examination had disclosed what appeared to be a bone tumor of the left half of the pelvis. Further study at The Clinic revealed a large bony mass that involved the left pubic bone and the ascending ramus of the ischium. This was diagnosed roentgenographically as an osteoma. An excretory urogram did not reveal any evidence of stasis in the ureters or renal pelvis. The outline of the bladder was normal in size and in shape, but was displaced to the right of the mid-line. The urine was normal; it did not contain any albumin or leukocytes. The remainder of the physical examination revealed nothing of importance.

Four days after the patient came to The Clinic, an osteoma, which weighed 360 grams and measured twelve by ten by seven centimeters, was removed through a pararectal incision by Dr. Henderson. (See Figure 1.) The tumor appeared to arise from the inner side of the innominate bone in close proximity to, but probably a little below, the acetabulum. It had a broad attachment to the ischium and the pubis. As the tumor was sharply circumscribed and had a smooth, hard surface, it was regarded as benign. The cut surface was composed of dense, hard bone, except for a small soft region,

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FIG. 1  
Osteosarcoma removed at operation.

about one by two centimeters, in the center of the attachment. Convalescence was uneventful, and the patient was dismissed thirty-two days after the operation.

Sixty-five days after operation, the left leg began to swell, and ten days later (December 4, 1933) he returned to The Clinic. Examination revealed swelling of the left thigh and leg (the left thigh and leg were six centimeters and four centimeters larger in circumference respectively than the right thigh and leg) and pitting oedema of the left ankle. A rather firm mass could be palpated in the left lower quadrant of the abdomen, just above the pubis. On account of the rapidity of the recurrence, the diagnosis of ossifying hematoma was considered. The roentgenologist reported that examination of the pelvis (Fig. 2) disclosed "osteoma overlying the left ischium and superior portion of the pubis, projecting into the left bony pelvis". A course of deep roentgen therapy was given from December 27 to 29, 1933, to ascertain whether the rate of growth could be restrained. This produced clinical improvement: the swelling of the thigh decreased, and the pain became less severe. When the patient was seen on January 18, 1934, it was found that the tumor had extended posteriorly to the intergluteal fold as an irregular bony outgrowth, which made sitting or lying on the back extremely uncomfortable. As the upper borders of the tumor seemed to have regressed slightly, another course of roentgen therapy was given from January 18 to 22, 1934. A roentgenogram of the thorax did not disclose any abnormality.

Increasing difficulty on defecation developed. On March 7, 1934, the patient passed bloody urine. Three days later, hematuria again occurred; this was accompanied by frequency of micturition. Examination revealed that the bony mass was larger and extended farther to the right in the pelvis than it had at the previous examination. Cystoscopic examination, which was performed on March 10, 1934, disclosed deformity and fixation of the prostatic urethra and vesical neck. There were bullous oedema of the mucosa and ulceration in multiple scattered regions around the internal sphincter; these

changes were suggestive of secondary involvement of the vesical neck and adjacent regions from an extravesical tumor. The dysuria, which was severe enough to interfere with the sleep of the patient, was relieved by an indwelling catheter. On March 17, the patient was dyspnoeic and complained of epigastric fullness and pain in the right side of the abdomen. The liver could be palpated ten centimeters below the costal margin and was nodular. Roentgenographic examination of the thorax disclosed extensive infiltrative changes, which involved the entire right lung and apparently also involved the opposite side. The distribution of the process indicated an inflammatory (bronchopneumonia) rather than a secondary malignant change. The patient failed rapidly and died on March 21, 1934.

At necropsy the external appearance was not remarkable except for pigmentation (roentgen rays) of the skin of the left lower quadrant of the abdomen and hrawny oedema of the left lower extremity. The pleural cavities contained serosanguineous fluid (the right cavity contained 300 cubic centimeters and the left, 200 cubic centimeters). The parietal and visceral pleura of both lungs was studded with firm grayish-white plaques, the largest of which was one and two-tenths centimeters in diameter. There were many recent fibrinous adhesions. On the cut surface of the right lung there were many small, raised, whitish, firm nodules. The left lung contained fewer and smaller nodules. On the diaphragmatic surface of the left lung there was a bony, hard, nodular mass, whieh measured two and five-tenths by two and five-tenths by one centimeters. (See Figure 3.)

The pericardial sac contained 200 cubic centimeters of clear straw-colored fluid. The heart was apparently normal. The abdominal eavity contained 500 cubic centimeters of turbid sanguineous fluid. The visceral and parietal peritoneum was studded with numerous, hard, grayish nodules (the largest ones measured two by three millimeters). The large intestine was free with the exception of the sigmoid colon, which was adherent to a hard bony mass in the left half of the pelvis. The liver weighed 3600 grams and was mottled with bright red and yellow areas. These were most numerous in the left lobe. The yellow areas were raised, thus giving a nodular appearance. There was moderate ulceration of the oesophagus. The gall bladder, the stomach, the pancreas, the small intestine, and the adrenal glands were normal. The colon was normal except for



FIG. 2

Roentgenogram of pelvis, revealing the tumor before operation.

the sigmoid colon, which, where it was adherent to the tumor, was infiltrated with a grayish-white tumor, which did not extend into the lumen of the bowel. The rectum was pushed far to the right side of the pelvis and also was infiltrated by the tumor. Both kidneys were normal except for dilatation of the pelves and ureters. The right ureter was partially obstructed by the tumor mass, but was patent throughout. The left ureter was completely obstructed in its terminal three centimeters by the surrounding bone tumor. Both ureters passed through the tumor before entering the bladder. The right ureter measured one centimeter in circumference above the tumor, and the left ureter measured one and five-tenths centimeters. A massive, hard, bone tumor filled most of the left half of the true pelvis and part of the right half. It arose from both pubic rami on the left side and extended upward about eight centimeters; it was situated behind the aponeurosis of the rectus muscle and was adherent to the aponeurosis. Posteriorly it involved the left ischium, the left half of the fourth and fifth lumbar vertebrae, all of the sacral vertebrae, and the descending ramus of the right ischium. The bladder was crowded far over to the right by the bone tumor which entirely covered the posterior wall of the bladder and invaded the deep muscle layers. (See Figure 4.) The bladder contained a large, old blood clot, and the mucous membrane around the trigon was rough and hemorrhagic. The prostate gland was normal in size and appearance, and was entirely surrounded by bone tumor. The left iliac and femoral veins passed through the tumor mass and were completely obstructed. The femoral artery, although narrow, was patent. The right femoral vein and artery were entirely free of the tumor mass. The periaortic lymph nodes were greatly enlarged. The testes and the thyroid gland were grossly normal.

Sections for microscopic examination were prepared from all the organs and from

the original as well as the recurrent tumor. The periphery of the original tumor was composed of compact interlacing bundles of spindle cells with elongated fusiform nuclei. This capsule blended without definite demarcation with a stroma of similar fibers in which the bundles coursed irregularly, so that some were seen to be cut in cross section, and others, in longitudinal section. Arising directly from this stroma, without the intervention of cartilage, were irregular spicules of bone, which were surrounded by osteoblasts. There were occasional small groups of osteoblasts that were unassociated with bone spicules. The stroma contained numerous vascular channels and occasional areas of fatty marrow. Bone, containing large amounts of fatty marrow, and thick bundles of



FIG. 3

Left lung; metastatic pleural carcinoma and bony nodule.

stroma, containing only occasional spicules of bone, were present in a section obtained from the small soft region on the surface of the attachment. Microscopic examination of sections of the recurrent tumor disclosed similar findings (See Figure 5.) The stroma, however, was thicker, and the nuclei were somewhat more irregular in size and in shape and more vesicular and had prominent nucleoli. There were some areas of fatty marrow. The spicules of bone were more irregular, and there was poorer ossification on the whole. A section was taken through the trigon of the bladder and the underlying bone tumor. The vesical epithelium was missing except in a few small patches. The submucosa was thickened and diffusely infiltrated with abnormal epithelial cells, which are characteristic of highly malignant tumors of the bladder. The cells were large and irregular in size; they had rather round nuclei, which contained a few dark chromatin granules and one or two large nucleoli. Some of the cells were multinucleated, and there frequently was evidence of mitosis. The cells were growing unrestrainedly in the vesical wall and the vascular channels; they even extended into the venous sinuses of the underlying bone tumor and into the vascular channels of the prostate gland, which was otherwise normal. Collections of carcinoma cells could be found in the dilated veins of the submucosa underneath grossly and microscopically normal vesical mucosa adjacent to the tumor. Some portions of the tumor in the vesical wall were necrotic. This probably was due to the rapid growth of the carcinoma rather than to the previous roentgenotherapy. The osteosarcoma infiltrated the adventitia of the vesical wall, and there were



FIG. 4

Recurrent osteosarcoma of pelvis surrounding carcinomatous bladder; obstruction of left ureter by both tumors.

a few spicules of bone in the deep muscle layers. The left ureter was surrounded by both carcinoma and sarcoma, and the lumen could not be identified. The osteosarcoma was found invading the lower end of the left rectus muscle. The occlusion of the femoral vein was due to an old thrombus, which contained some carcinomatous cells. The thrombus had become organized and recanalized, and a few small channels had been formed near the periphery of the thrombus. The femoral artery was small, but otherwise normal. There was a thick plaque of carcinoma cells invading only the adventitia of the sigmoid colon, where it was adherent to the pelvic tumor.

The liver contained only carcinomatous metastasis. Many of the metastatic nodules had undergone infarction; they were entirely necrotic in the center and were surrounded by a zone of polymorphonuclear leukocytes and an outer hemorrhagic zone, which accounted for the gross yellow and red color of the nodules. Tumor thrombi could be found in vessels near the infarcts. The carcinoma cells were also growing freely in the sinusoids of the liver. The major part of the metastatic involvement of the lungs was carcinomatous in nature. The cells were growing freely in the alveoli, where their epithelial character could best be studied. (See Figure 6.) The bony nodule in the left lung resembled the primary osteosarcoma in all respects. On one edge of this nodule there was an area of cartilage from which the adjacent bone was taking its origin. Some of the marrow spaces contained carcinoma cells.

The extent of the metastasis and the infiltration of the older osteosarcoma indicate that the carcinoma obviously was the more rapidly growing tumor.

Most of the patient's symptoms were apparently adequately explained by the presence of the bone tumor alone. It was not until necropsy was performed that the second, but more malignant, tumor was discovered.

#### COMMENT

There are at least two unusual features of this case. The most important one is the deceptive character of the osteosarcoma. As it grew rather slowly, was rather well localized, and possessed gross characteristics of the so-called benign osteoma, its true nature could only be discovered by careful study of sections obtained from different portions. In some of these, the atypical proliferation of the stromal elements and the irregular and anomalous formation of bony tissue clearly suggested its malignant tendencies. This conclusion was further supported by the rapid (in two months) recurrence of the bony growth, its extensive involvement of the pelvic bones, and the filling of the pelvis itself by a growth similar to that removed at operation. In addition, the tumor invaded the rectus abdominis muscle and vesical wall, and at least two nodules which were found in the lungs corresponded histologically to the structure of the primary tumor. Why there should not be more widespread invasion of tissues, why the metastasis should be so small in extent and confined to two sharply localized regions of the lungs, and why with such a benign general aspect the tumor should grow with such rapidity and still manifest well-differentiated bone formation, are questions which cannot, of course, be answered. The possibility that all real osteomata are osteosarcomata and should be so regarded deserves careful consideration.

The second feature concerns the presence of a second, wholly different, and apparently completely unrelated type of malignant tumor. While almost all of the clinical phenomena could be ascribed to the slower

growing and more benign appearing osteosarcoma, the undoubted reason for the rapid failure of this patient's vitality was the carcinoma of the bladder. Its characteristics of malignancy were clearly typical. So diminished had become the inhibition to its growth and spread that the

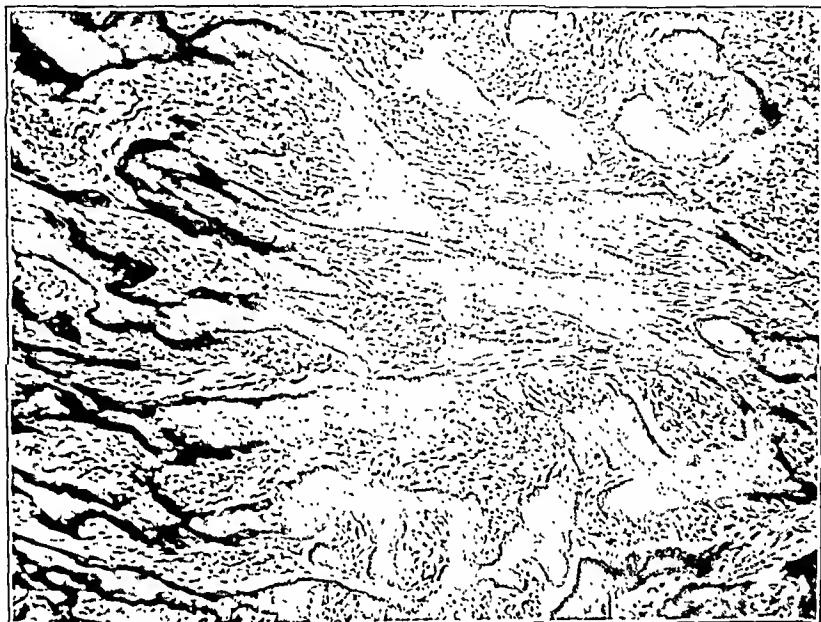


FIG. 5

Recurrent osteosarcoma of pelvis; stained with hematoxylin and eosin ( $\times 80$ ).

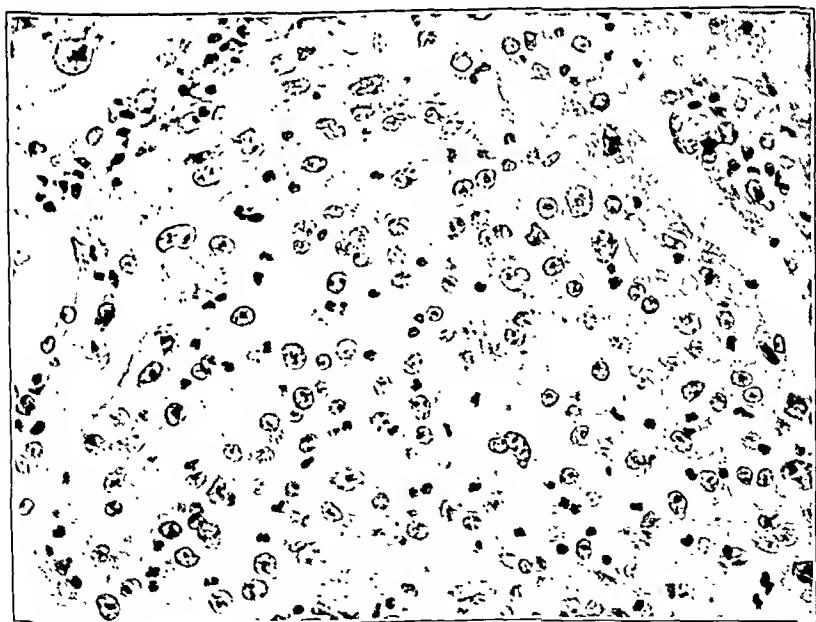


FIG. 6

Metastatic carcinoma of lung; stained with hematoxylin and eosin ( $\times 270$ ).

blood stream contained carcinoma cells, and metastasis and invasion affected probably every tissue of the body, certainly the osteosarcoma, the lungs, the lymph nodes, the liver, and the diaphragm.

The invasion of the outer wall of the urinary bladder by the sarcoma and its presence in the pelvis might be assumed to furnish a reason for the development of malignancy in the mucosa of the bladder, but this is a remote possibility and wholly theoretical.

#### SUMMARY

In this interesting and unusual case of coexisting primary osteosarcoma of the pelvis and primary carcinoma of the urinary bladder, the bone tumor was originally considered benign on the basis of history, clinical examination, and examination of the gross specimen after operation. Rapid recurrence took place and caused much distress because of the situation and extent of the tumor. Another primary tumor, a highly malignant and rapidly growing carcinoma of the bladder, brought about a fatal termination two weeks after the first symptoms referable to the urinary tract were noted.

## A METHOD FOR TREATING DISPLACED FRACTURES OF THE PELVIS

BY EUGENE L. JEWETT, M.D., ORLANDO, FLORIDA

Markedly displaced fractures of the pelvis present some of the most difficult problems with which one is confronted in traumatic practice. Often these fractures are never adequately reduced, and infrequently fibrous union results. It is surprising, however, to find how little disability or discomfort may result in a patient with one or more non-united fractures of the pelvic ring.

Figure 1 shows the apparatus used in the treatment of the case to be reported. The writer had previously used the Roger Anderson "well-leg traction splint" for fractures of the pelvis, but the addition of the turn-buckle device and the leather strap about the ankles were features which he believed had not been mentioned in the medical literature. However, after the first draft of this article had been written, it was called to his attention that a very similar method had been described by Dr. S. A. Jahss in *The Journal of Bone and Joint Surgery* for April 1935. Also, Dr. P. B. Magnuson in the second edition of his book on "Fractures", published in 1936, described a like method, using a board in place of the turn-buckle, the fulcrum over which the casts are manipulated as levers. Both of these references were seen by the author after the following case had been treated. No attempt is made here for priority, the only thought being to offer another useful suggestion for the treatment of these fractures.

The patient, a young woman, twenty-five years old, was in an automobile accident on September 26, 1937. The car turned over several times, finally landing on its side, and the patient's prone body was impinged between the upper side of the car and the ground. While being taken to the hospital ten miles away, she regained consciousness, but remained in a confused state for several hours. Clinical examination showed multiple injuries, the most noticeable of which were a marked posterior displacement and altered obliquity of the right side of the pelvis when viewed posteriorly. The sacro-iliac joint was unquestionably dislocated, and the palm of the hand could be placed in the depression there. The lacerations and abrasions were treated while the patient was recovering from shock. For a few days she was kept in bed on her back, with the right thigh and knee semi-flexed, in which position

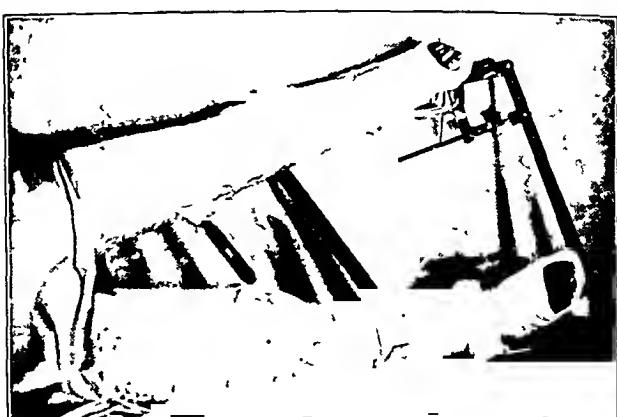


FIG. 1  
Apparatus in place.

she was fairly comfortable. She voided voluntarily quite a bit of bloody urine, but each specimen showed less blood than the previous one. In ten or twelve hours after the injury, the urine was clear.

When the patient recovered from shock, roentgenograms were taken, which confirmed the clinical diagnosis of multiple fractures of the right pelvis, dislocation of the right sacro-iliac joint, fracture of the right clavicle, and fractures of the twelfth rib on the left and of the eleventh rib on the right at their spinal articulations. These roentgenograms were taken in a local hospital with the patient on a stretcher; therefore, they are not as clear as one would wish to have them. Figure 2 shows the fractures of both pubic rami on the right, with marked displacement. There was no tenderness over the lumbar spinous processes, and a lateral roentgenogram showed no compression of any of the vertebral bodies. Even though fractures of the left mid-lumbar transverse processes were suspected clinically, no attempt was made to obtain better roentgenograms, since demonstration of these fractures would not have altered the treatment. The patient was in no condition to have needless roentgenograms taken at this time.

Seven days after the accident, the patient was moved to the Orange General Hospital, in Orlando, Florida, and the next day the author undertook the correction of the pelvic displacement. Under avertin-gas-oxygen anaesthesia, a Roger Anderson well-leg splint and cast were applied, incorporating into the cast Steinmann pins, one-eighth of an inch in diameter, which had been inserted through each tibia. This practice of using a Steinmann pin through the tibia of the well leg, thereby removing any pressure on the sole of the foot of that leg, is a most excellent procedure, and was suggested to the writer by Dr. Frank Gray of Orlando more than two years ago. An extra long arm was made for the lever bar, so as to obtain much more abduction of the legs than is possible with the usual splint. After the leg cast and splint had been applied, a turnbuckle was incorporated in the cast a little above the knees, and a leather strap was placed about the casts at the level of the middle of the lower leg (Fig. 1). The casts were well padded with felt and carefully molded, but, in spite of this, two pressure sores developed, which healed only about two months after the injury.

The patient was next transferred to the fluoroscopic table, where downward traction was made with the splint, and abduction of the thighs was instituted by means of the turnbuckle. The leather strap permitted abduction of the hips with the ends of the casts held stationary. The patient was on the table about an hour, during which time four roentgenograms showed the progress made in the correction of the pelvic displacements and malalignment. Figure 3 shows the position of the pelvis after the first adjustment of the turnbuckle and screw traction. Several more roentgenograms were taken during the manipulations, all of which showed a distinct improvement in the position of the fragments. It was found that the abduction by means of the turnbuckle was much more effective with the leather belt to limit abduction in the lower legs than when the belt was not used. The belt can be placed anywhere along the cast, from the knees down to the end of the splint. During the reduction, manual manipulation was employed to correct the rotation of the right side of the pelvis, and a mallet was used to pound the area of the iliac crest, using a thick felt as padding. This pounding was done only after it was thought that the alignment of the pelvis was fairly good. When the roentgenograms showed good position of the fragments, a tight moleskin bandage was applied completely about the pelvis, so as to hold the bony parts together. This was thought to be a better method for this patient than a pelvic sling. The pelvic moleskin strapping had to be replaced several times, and was finally removed about six weeks after the injury.

Figure 4, taken eight weeks after the accident, shows excellent contour of the pelvis, with, however, some asymmetry of the two sides, due, the writer believes, to the obliquity of the pelvis rather than to displacement of the fragments. The sacro-iliac joint seems to be intact, and the fractures of the ilium, the pubis, and the ischium show abundant callus. Compression of the lumbosacral articulation on one side and a gaping on the other are noted, which were to be expected from the shearing action of the apparatus. A non-displaced, somewhat comminuted fracture of the upper pubic ramus on the left:

shown in the later roentgenogram, which was not seen in the first indistinct picture.

The fracture of the clavicle was treated by a small pillow beneath the scapula and a sandbag over the distal end of the clavicle. Clinical and roentgenographic examinations showed an excellent result at the end of four weeks.

The cast and apparatus were left in place for eight weeks and then removed, the wires were withdrawn while the patient was in bed, without any anaesthesia and with very little discomfort.

The patient was allowed to walk ten weeks after the injury, wearing a sacro-iliac and lumbar girdle and, of course, using crutches. Exactly three months after the accident,

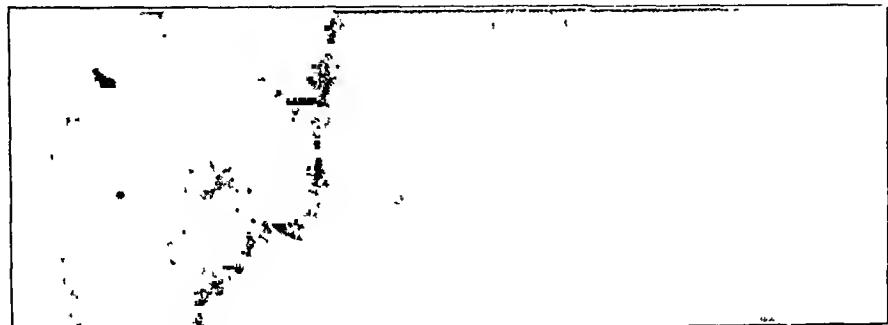


FIG. 2

Roentgenogram showing fractures of both pubic rami on the right, with marked displacement.

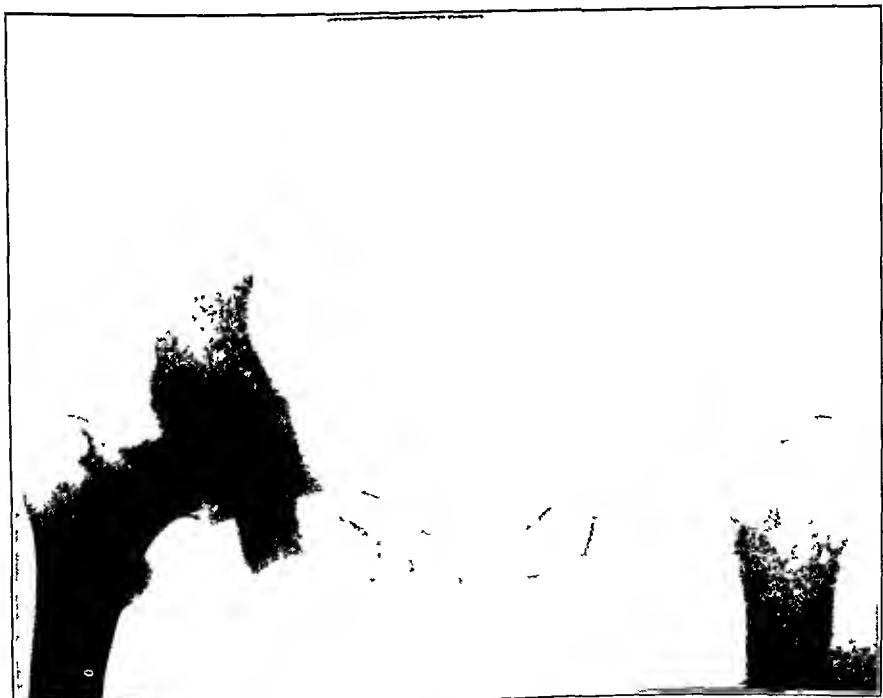


FIG. 3

Roentgenogram showing position of pelvis after first adjustment of turnbuckle and screw traction.

she was walking without crutches and had no limp, curvature, or any complaints except some stiffness in the joints of the lower extremities. About this time she began to drive her car and even went to a dance.

Five months after the injury, final roentgenograms were taken. (See Figure 5) She has no symptoms, except some stiffness in the lower back when she bends over for too long a period, such as in packing luggage or working in the garden. She has no tenderness anywhere, and there are none of the usual signs of sacro-iliac strain (Lasègue's, Mennell's, McBride's, or Gaenslen's). She is still wearing the girdle, which will be discontinued gradually from now on.

#### COMMENT

This type of fracture is ideally suited to treatment by the Roger Anderson well-leg traction splint, which ensures easier care, less discomfort and more rapid correction than other methods. It was surprising how little discomfort or pain in the pelvis the patient had after this apparatus was in place. The author believes that it would be better to apply the splint one day and adjust it the next day after the plaster is entirely dry, as the abduction force is considerable, and is liable to bend a soft cast.

The use of moleskin strapping completely about the pelvis after the fractures are reduced, with the iliac crest well padded, seems to be a better method in treating multiple fractures than the use of a sling or hammock. This method ensures absolute immobilization as well as reduction, both



FIG. 4

Roentgenogram, eight weeks after injury, showing excellent contour of pelvis.

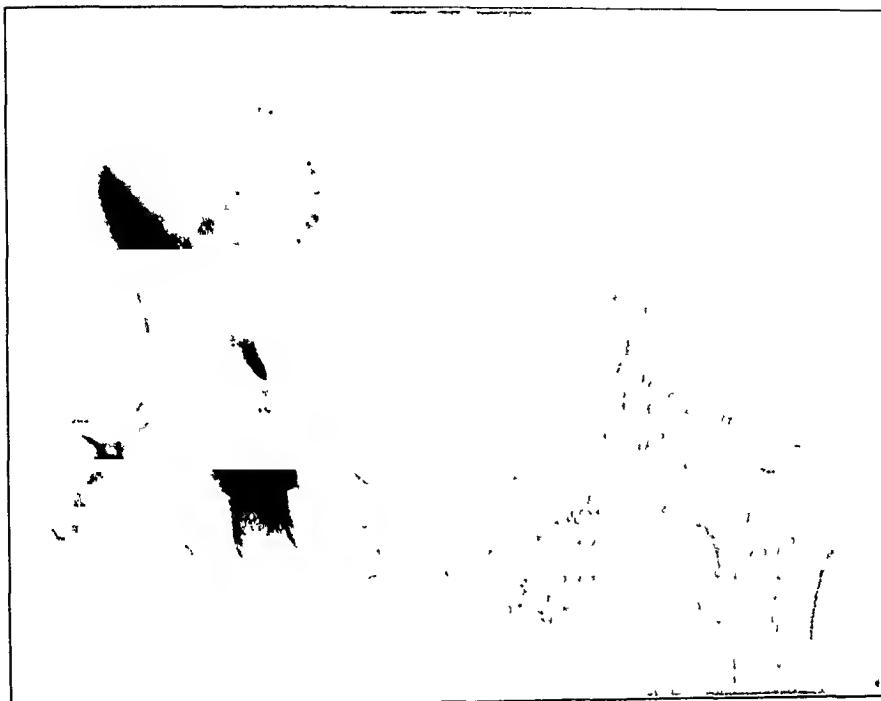


FIG. 5  
Roentgenogram, five months after injury.

of which are essential for good healing of extensive fractures of the pelvis. After the first two or three days, this patient was turned on her abdomen without much of any difficulty or pain. The care of the patient was very easy, and no pressure sores developed on her back. Following removal of the cast, the main difficulty was to regain the knee action. This was accomplished, however, fairly rapidly with active motion combined with the usual physiotherapeutic aids. Five months after the accident the joints of the lower extremity had practically normal painless motion.

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## OBJECTIONS TO THE USE OF KIRSCHNER WIRE FOR FIXATION OF FEMORAL-NECK FRACTURES

BY SETH SELIG, M.D., F.A.C.S., NEW YORK, N.Y.

Several years ago, impressed by the work of Telson and Ransohoff, the author used Kirschner wires for the fixation of intracapsular fractures of the neck of the femur in fourteen patients. Since the results were not entirely satisfactory in his hands, he has discarded the use of wires in favor of more rigid devices.

One of the objections to the use of Kirschner wires is their lack of rigidity and strength. This is strikingly demonstrated in the following case.

L.L., male, aged eighty-three, suffered an intracapsular fracture of the neck of the left femur in July 1934. After a satisfactory reduction, four Kirschner wires were inserted across the fracture line into the head (Fig. 1). Two days after the operation, the patient stated that the hip felt entirely normal and that he was convinced he could walk out of the hospital. In spite of the writer's disapproval, this semile, arteriosclerotic patient got out of bed the next day. He put his full weight on the fractured hip, bending the four Kirschner wires to a right angle (Fig. 2).

Another objection to the use of Kirschner wires is their tendency to "wander" deeply into the tissues. This tendency is not confined to wires alone, as shown by the report of Grant. This observer removed a bone peg from the bladder of a patient four months after its insertion into the neck of the femur. It has been noted that, although the wires appear satisfactorily placed in the anteroposterior roentgenogram, lateral views often show that one or more are anterior or posterior to the head. The poorly placed wires are more prone to "wander" than those which have been properly placed. However, even correctly placed wires do not remain fixed, as the following case graphically demonstrates.

M.C., female, aged fifty-three, was admitted to the Orthopaedic Service of the Mount Sinai Hospital with an impacted intracapsular fracture of the neck of the right femur of twenty-four hours' duration. Because in impacted fractures the fragments occasionally become displaced even when immobilized in plaster, it was decided to insert Kirschner wires for immobilization.

Under avitamin anaesthesia and with the aid of anteroposterior roentgenograms, five Kirschner wires were placed through the skin across the fracture line into the head of the femur (Fig. 3-A). The wires were clipped off, and the ends were covered by the skin. A lateral check-up roentgenogram (Fig. 3-B) revealed excellent position of the wires.

The patient made an uneventful recovery and was permitted up in a wheel chair on the seventh postoperative day. At the end of a month, it was decided to send the patient to another hospital for convalescence, but she chose to return to her family physician, and left the hospital on crutches five weeks after the insertion of the wires. The author subsequently visited her for follow-up purposes and found that several weeks later she had gone to her family physician, who attempted to remove the wires in his office. He succeeded in removing two, but a third wire was broken in the attempt. The patient later went to a second physician, who removed a third wire in his office, leaving two in place. At the time of the writer's visit, four months after the fracture, motion of

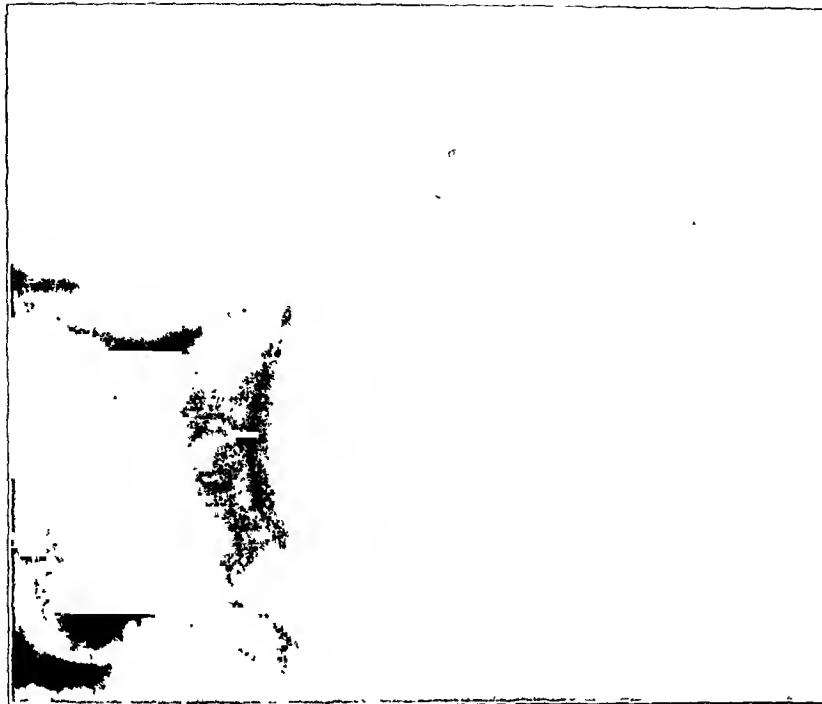


FIG. 2

L. L. Roentgenogram showing the wires bent to a right angle after weight-bearing.



FIG. 1

L. L. Roentgenogram showing four Kirschner wires immobilizing the fracture of the neck of the femur.



FIG. 3-B  
*M. C., Anteroposterior roentgenogram immediately after the insertion of the Kirschner wires.*



FIG. 3-A  
*M. C., Anteroposterior roentgenogram immediately after the insertion of the Kirschner wires.*



FIG. 4-B

M. C., Anteroposterior and lateral roentgenograms four years after insertion of wires, showing the "wandering" of one wire across the hip joint into the pelvis.



FIG. 4-A

the hip was free and painless, and the fracture was clinically healed. The patient refused to permit the taking of roentgenograms at that time.

The author next saw the patient in August 1938, almost four years later. She walked into his office to tell him that the hip felt well and had given her no pain, and that she had been working as a practical nurse for the past two years.

Physical examination showed no shortening of the right lower extremity and an excellent range of motion in the right hip. Flexion was limited to 90 degrees, and abduction, to 30 degrees. Rotation was free, but hyperextension was slightly limited. There was an area of local tenderness over the posterior aspect of the thigh at its mid-point, and attempts to pass the limits of hip motion mentioned caused pain referred to the same area.

Roentgenographic examination revealed firm union of the fracture of the femoral neck; the fragments were in excellent position with normal articular surfaces. Two of the Kirschner wires could be seen (Fig. 4-A). One had been broken off, and was entirely within the substance of the femur, but the other wire had penetrated the acetabulum and had entered the pelvis to the extent of about a quarter of an inch. The inner wall of the pelvis at the site of the wire was eroded for about three-quarters of an inch, probably due to movement of that end of the wire during locomotion. Lateral views confirmed the excellent central position of the wires (Fig. 4-B).

The patient was advised to enter the hospital and have the long wire removed before it "wandered" farther into the pelvis. The possibility of its penetration into one of the hollow viscera or a blood vessel was explained, but the patient refused to have any operative procedure performed, because she felt entirely well.

This objection to the use of Kirschner wires—their tendency to "wander" deeply into the tissues—has been overcome by threading the wire and by using a fixation nut screwed against the lateral aspect of the femur.

The other objection—the lack of rigidity and strength—militates against their continued use for internal fixation of fractures of the neck of the femur. The author feels that this objection more than counterbalances all the advantages.

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## CHONDRO-OSTEODYSTROPHY (MORQUO'S DISEASE)

### PROGRESSIVE KYPHOSIS FROM CONGENITAL WEDGE-SHAPED VERTEBRAE

BY JOHN F. POHL, M.D., MINNEAPOLIS, MINNESOTA

*From the Department of Orthopaedic Surgery, the Children's Hospital, Boston,  
and Harvard Medical School*

Morquio, in 1929, published a description of a familial form of generalized osseous dystrophy, with his observations. Subsequent writers have affixed his name to the disease which he described. Briefly, the condition is a disturbance of development of the osseous system, congenital in origin, but the symptoms are not as a rule obvious at birth, or for some time afterward. When the child assumes the upright posture, as in standing, one of the most characteristic findings is first noticed,—the appearance of a distinct kyphosis of the spine. This is usually at the level of the thoracolumbar junction, and is due to wedge-shaped malformation of the bodies of one or more vertebrae. At this time the deformity of the spine has very much the appearance of an early tuberculous gibbus. The roentgenogram is so suggestive of tuberculous collapse of the involved vertebrae that children with this disease have been known to have been hospitalized for long periods of time for treatment of tuberculosis of the spine. The pain and muscle spasm which accompany tuberculosis of the spine are not present, however, and the disclosure of lesions in other parts of the skeleton eventually brings to light the true nature of the affliction.

General development is, as a rule, delayed but little. As development proceeds, skeletal deformities occur and advance. Prominently noted are enlargement of joints, knock-knee, misshapen head, and depression of the sternal portion of the chest. The neck is short, and the head characteristically appears to sit in a concavity on top of the thorax. Roentgenographic examination discloses fragmentation and distortion of the epiphyses of the long bones. There is relatively little disturbance in growth in length of the extremity, but there occurs malformation of the joints, with resulting deformity and limitation of function in motion. The condition, then, is primarily a disturbance of the metamorphosis of cartilage into bone, but a dysplasia rather than an aplasia. Pathognomonic features of the disease occur with fair regularity. Whether or not the condition is entitled to recognition as a distinct entity probably rests on an explanation of the fundamental cause of dyschondroplasia.

The disease is not limited to the skeletal system or to the embryonic germinal layer from which bone arises. Clouding of the cornea has been observed. The skin is often thick and inelastic. Sclerodactyly is sometimes so pronounced as to interfere seriously with the function of the fingers. The hair is often coarse and dry. Morquio and some subsequent authors have stated that intelligence is normal. The children observed in

this Clinic have definitely proved to be subnormal when subjected to accurate psychometric appraisal. Premature synostosis of the sutures of the skull results in malformation of the head, as well as in increasing intracranial pressure. Atrophy of optic nerves and loss of vision accompany this process, and the encephalogram has shown an actual deficit of brain tissue.

Antedating the paper of Morquio in 1929 are many descriptions of cases of bizarre or unusual forms of rickets, dwarfism, and achondroplasia. Many of these are very similar to the cases described by Morquio. However, roentgenographic or other indisputable evidence is lacking, and the exact identity of the disorder described perhaps cannot be established. At least, considerable credit must be given Morquio for recognizing the condition as an entity distinct from the other processes mentioned. Previously unmentioned is the paper from the Orthopaedic Clinic of the Children's Hospital, Boston, by Dr. Thomas Foster Wheeldon published in January 1920 under the title: "A Study of Achondroplasia. Introducing a New Symptom—a Wedge-Shaped Vertebra." One of the patients mentioned was a child, aged twenty-two months when first seen. The

complete description incorporated in the paper—including roentgenograms, photographs, and body measurements—places the child unquestionably in the classification of the condition now known as Morquio's disease, but not to be described by Morquio until nine years later. It was apparently included in the study of achondroplasia simply because the condition found in the skeleton represented an "aplasia of chondrium". This patient has now reached the age of twenty-two years and has been under the continuous observation of the Department of Orthopaedic

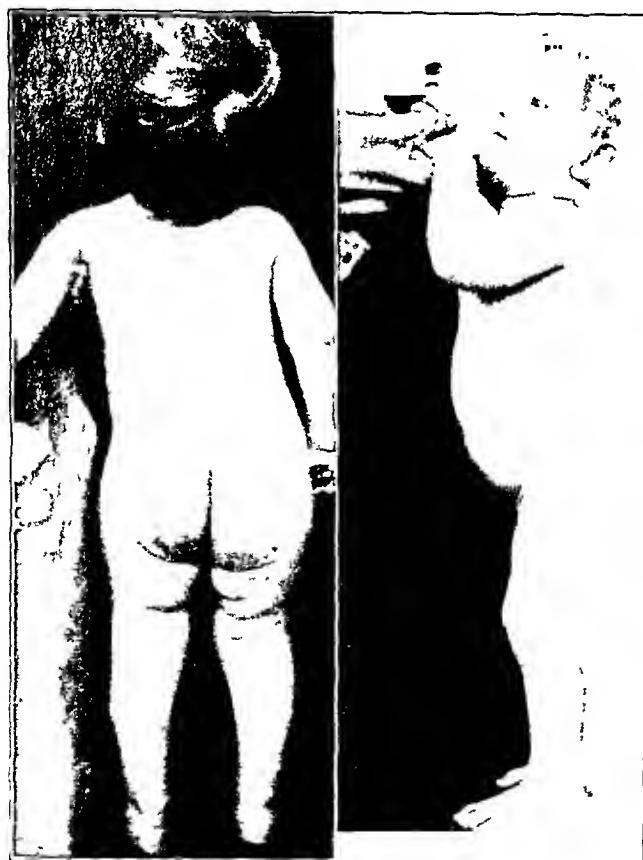


FIG. 1

Patient at age of twenty-two months. Height: 30 inches. Weight: 21 pounds, 11 ounces.

Surgery of the Children's Hospital, Boston, since the original communication. It may be of interest to record the history and development of this child, which has taken place in the twenty years since the first description. Probably of more concern is the question of early prevention of deformity in other children now being seen with this disease, who present the same symptoms.

I. P., a girl, of Italian parentage, was admitted to the Children's Hospital on April 6, 1918, at the age of twenty-two months. (See Figure 1.) She was one of four siblings; the other three were living and normal. She was brought to the Hospital because of deformity of the back, which had been first noticed at the age of two months, but which had become more pronounced since she had begun to stand at the age of ten months. In so far as the parents had observed, the child's development, appearance, and behavior were otherwise quite normal. On examination, the head was squared and the face suggested cretinism. The neck was short. There was an increase in subcutaneous fat. The hands were short and the fingers thick. The joints were enlarged and thickened. The hips were limited in motion, especially in abduction. The most obvious finding was a fixed kyphos at the

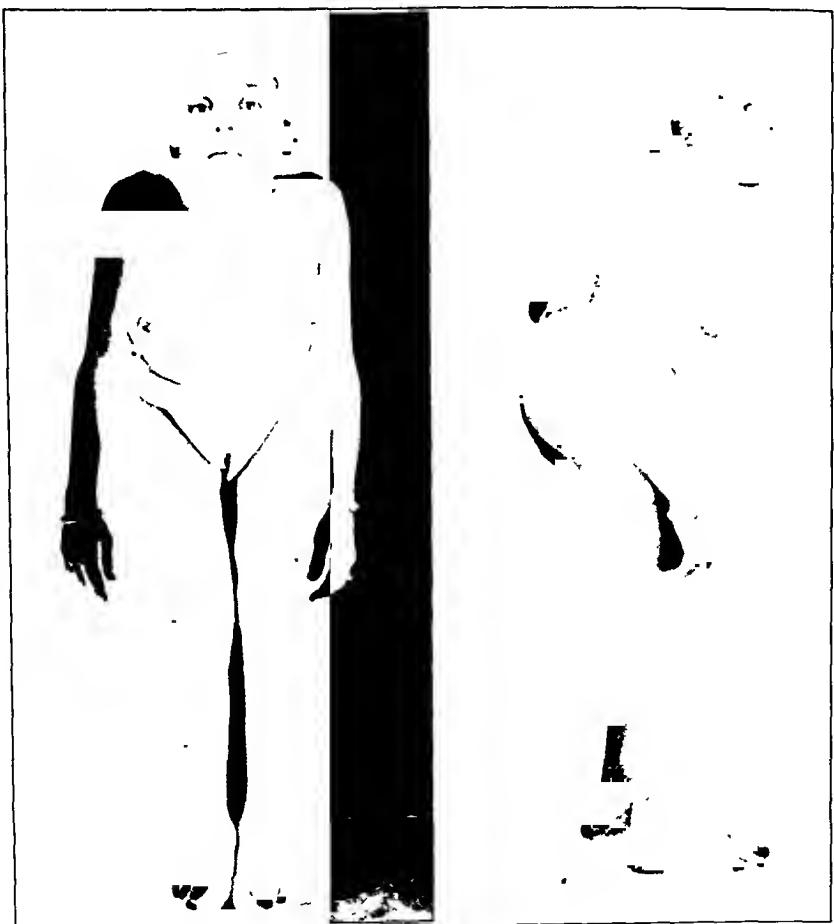


FIG. 2

Patient at age of twenty-two years. Height: 45 inches. Weight: 74 pounds.

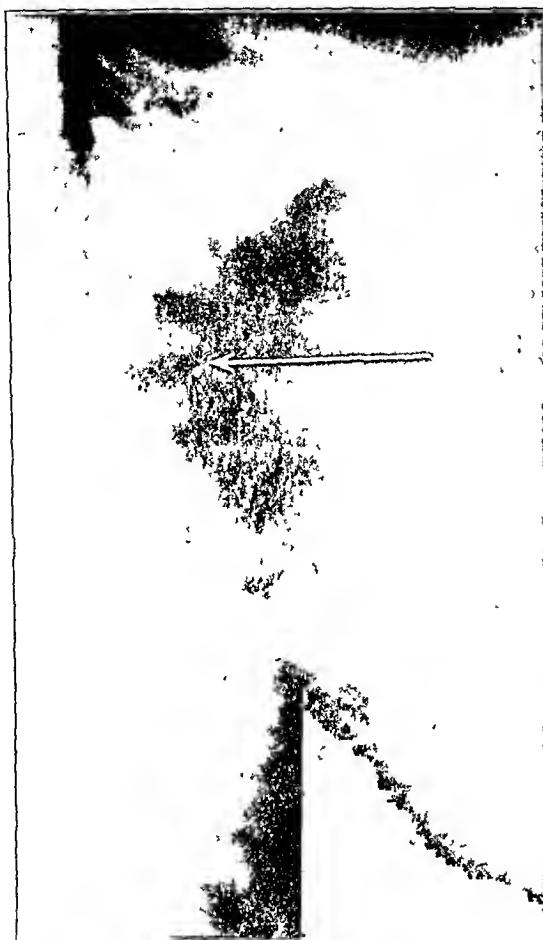


FIG. 3

Appearance of wedge-shaped body of twelfth thoracic vertebra at age of twenty-two months.

neck is short, so that the head appears to sit in a concavity on top of the chest.

Most striking is the severe kyphosis of the spine, so fixed that the ribs permanently overlap the pelvis anteriorly.

The joints—particularly those of the elbows, the shoulders, and the knees—are enlarged and thickened. Abduction of the shoulders is limited to 90 degrees. The elbows present a flexion deformity of 20 degrees and the knees, of 10 degrees. Motions in the elbows and knees are otherwise unrestricted. There is a slight genu valgum of the knees.

Both hips show flexion deformities of 10 degrees, but motion in flexion is restricted only by the protruding chest. Abduction is limited to 10 degrees, and external rotation is completely restricted at the hip.

The hands and feet are short and stubby, and the skin is thickened. Skin folds are poorly marked on the palmar and plantar surfaces. Motion and flexibility of the hands and feet, including the wrists and the ankles, are, however, unrestricted. The nails appear normal, as do the teeth.

Figure 4 shows the marked kyphos of the thoracolumbar region, with consequent forward and downward tilting of the thorax. The body of the twelfth thoracic vertebra is rudimentary and wedge-shaped, and that of the first lumbar vertebra is narrowed. The pelvis is distorted, and the acetabula are shallow. The femoral heads are flat, and the necks are short. The joint surfaces of the femora and the tibiae at the knees are dis-

thoracolumbar region of the spine. Roentgenographic examination disclosed a wedge-shaped body of the twelfth thoracic vertebra (Fig. 3). There was also involvement of the epiphyses of the long bones.

An attempt was made to correct the deformity of the spine by plaster casts. This was ineffective, however, and was discarded after four months. The child remained at home then until the age of seven, with no attempt at treatment. The deformity of the spine became progressively more pronounced and, at the age of seven, the child was placed in the Canton State Hospital School. Except for the deformity, there had been no symptoms referable to the spine, and no further treatment was attempted. She remained at Canton until discharged at the age of twenty-one, the age limit of residence at the School.

At the age of twenty-two, the patient presents a most striking appearance (Fig. 2). She is astonishingly short, being less than four feet tall, but the extremities are of good length, and the small stature is due mainly to great shortening of the trunk because of the kyphosis of the spine. The head appears large because of the prominent forehead, but actually measures twenty and one-half inches in circumference. The

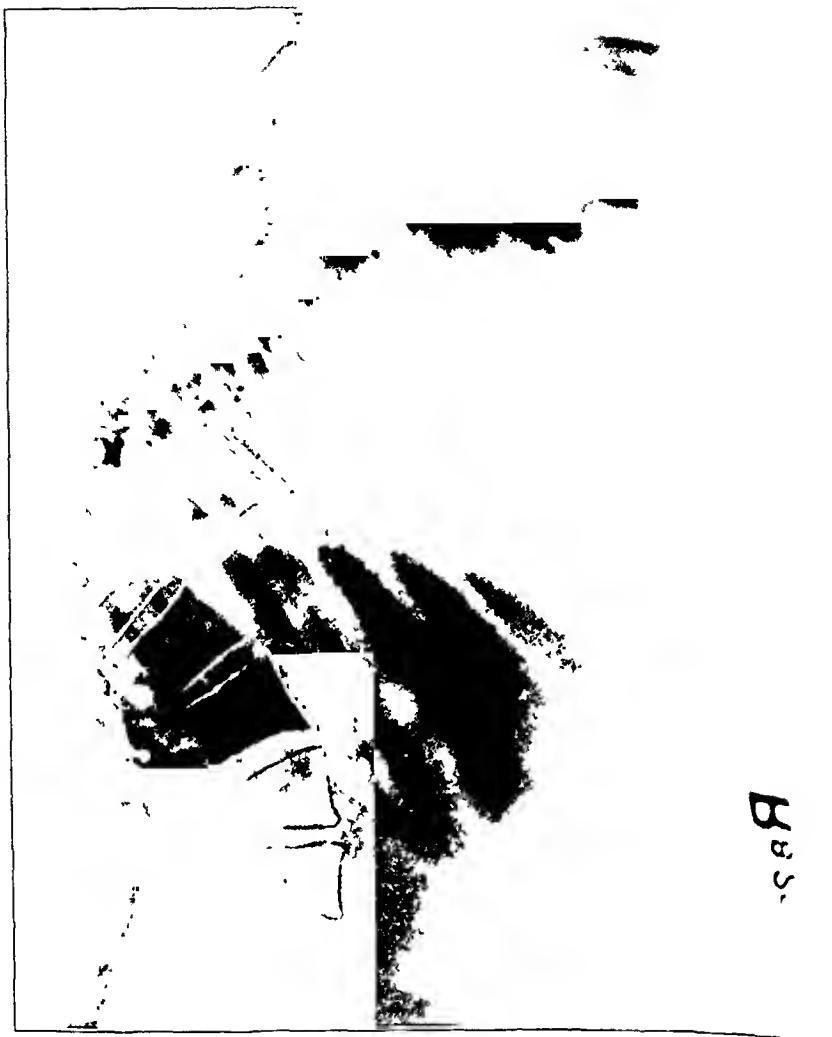


FIG. 4

Roentgenogram at age of twenty-two years (patient untreated). Marked collapse of the thorax has occurred.

torted. The metatarsals of all the toes are shorter than normal, but there is a disproportionate shortening of the second and fourth. The metacarpals are also shorter than normal, and the phalanges of the fingers are short and stubby, with consequent spade-like appearing hands. The skull reveals no abnormality.

The patient had never had any symptoms referable to the kyphos, either locally or distal to the angulation of the spine. There had been no disturbance of respiratory or cardiac function. No neurological changes could be observed in the extremities. Muscle strength had always been good, and her recreation consisted of walking, swimming, and skating.

There had been no interference with the development of female sexual characteristics. Catamenia was established at the age of fourteen and had always been quite regular. Secondary characteristics appeared entirely normal. No evidence of any specific glandular dysfunction was present.

The patient has a pleasing facial expression, not unintelligent to casual observation. She expresses little change with emotion, however, and her reactions and comprehension

are probably subnormal. An attempt at scholastic education demonstrated early that the child was definitely deficient, and at the Canton State Hospital School efforts were accordingly directed toward vocational training. She finished the formal eight grades of the School at the age of twenty, and at this time had an average of 83.8 on the Stanford Achievement Test. Her Intelligence Quotient was, however, set at 65. Her vocational training had been in fine needlework, in which she was adept and became exceedingly skillful. At the time of discharge from the School it was felt that she could probably manage an independent existence, providing sufficient work was available.

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# UNILATERAL CONGENITAL ELEVATION OF THE ILIUM OR CONGENITAL DISLOCATION OF THE SACRO-ILIAC JOINT

## A RARE ANOMALY

BY DANIEL H. LEVINTHAL, M.D., F.A.C.S., AND IRVING WOLIN, M.D.,  
CHICAGO, ILLINOIS

We wish to report an unusual developmental anomaly of the pelvis, which resembles in several respects the obliquely contracted pelvis of Nagele. Our case, however, differs definitely from the characteristic deformity of Nagele, and we have been unable to discover any previous description of this anomaly in the literature.

R. A., a white woman, twenty-seven years old, was seen on April 4, 1938. She complained of pain in both thighs and of pain and swelling of the right foot of one year's duration. She had a congenital deformity of the right lower extremity, and had always limped. The right foot had been operated on when the patient was ten years old and again when she was thirteen. She had had no pain until one year previous to our first examination.

When next seen on June 6, 1938, the patient complained of severe pain in the lumbosacral and left lumbar regions of two weeks' duration, which had come on spontaneously. She walked with a definite limp on the right. There was a right lumbar scoliosis, with shortening of the right lower extremity, amounting to one and seven-eighths inches, the right buttock, thigh, calf, and foot were smaller than those of the left side. Motion in the spine was limited, particularly forward and right bending, which produced pain in the left lumbar and left lumbosacral regions. The Lasègue test, given bilaterally, elicited pain in the left lumbosacral area. The left lumbar region was acutely tender. The right foot was in a position of fixed equinovarus, and the patient had no power of abduction or of dorsiflexion.

Roentgenograms of the lumbosacral spine and pelvis (Figs. 1-A and 1-B) revealed a most unusual pelvic anomaly, which prompted our unsuccessful search for similar cases in the literature. The films showed a marked pelvic asymmetry, with a right lumbar scoliosis. There was a spina bifida occulta of the first sacral segment, and the remaining sacral neural arches appeared wide open. The right ala of the sacrum was partially absent, and was smaller than the left. The sacral foramina were approximately equal in size. Only one small coccygeal segment was visualized, articulating with the right lower border of the sacrum. The right ilium was distinctly smaller than the left, and its crest was one-half an inch lower. The pubic symphysis was displaced to the left. The right ischial and pubic rami were displaced superiorly, as was the ischial spine, which was apparently much enlarged. The curve of the right iliopectineal line was flattened, and the pelvic inlet assumed an obliquely elliptical configuration. The right posterior inferior spine was absent, the greater sciatic notch extending to the posterior superior spine. The auricular surface of the right ilium was very small and made a distinct articulation with the right transverse process of the fifth lumbar vertebra, the appearance was that of a *congenital elevation of the ilium or sacro-iliac dislocation*.

The acetabula were about on the same horizontal level, but the right one was more oblique. The right femoral head was transversely elliptical. Although the roentgenogram was made with both thighs in as nearly identical positions as possible, with the patellae directed straight upward, the right lesser trochanter was quite prominent and the

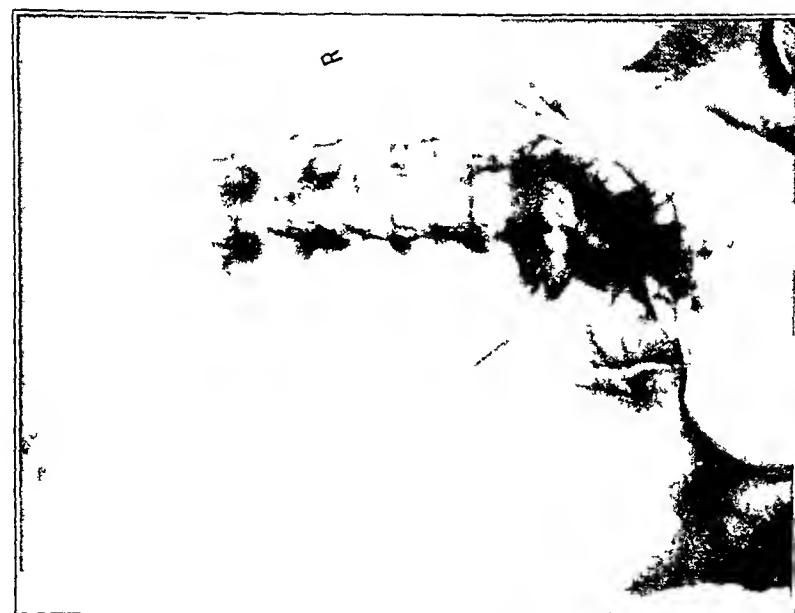


FIG 1-A



FIG 1-B

Roentgenograms of lumbar spine and pelvis, showing congenital elevation of the right ilium or unilateral congenital dislocation of the sacro-iliac joint. Note articulation between the right transverse process of the fifth lumbar vertebra and the auricular surface of the ilium.

right femoral neck appeared foreshortened. The right femur was narrower and less dense than the left.

This condition is apparently the result of arrest and distortion of a normal epiphyseal development in the sacral and iliac centers. A study of the embryological formation of the pelvis explains the derivation of this anomaly. Prentiss and Arey state that the cartilaginous plate of the os coxae is at first so placed that its long axis is perpendicular to the vertebral column, and that later it rotates to a position parallel with the vertebral column and *shifts slightly caudally* to come into relation with the first three sacral vertebrae. In our case there has been a failure of the ilium to descend, with a persistence of the foetal condition, in which the ilium is at the lower lumbar level. It is quite analogous to Sprengel's deformity, in which the scapula fails to descend. For this reason, we propose to use the term "congenital elevation of the ilium", although, on our first examination of the roentgenogram, the impression was that of a *sacro-iliac dislocation*.

A detailed description of the development of the sacrum is given by Adair. In the primitive or blastemal vertebrae, three centers of chondrification appear on each side,—for the vertebral body, for the neural arch, and for the costal process. The two centers for the body soon fuse. The neural processes give rise to radicular, articular, transverse, and laminar processes. The radicular processes fuse with the transverse processes of the neural cartilages. Later union of the costal processes forms the sacral surface, which articulates with the ilium. All the sacral centers form a single cartilaginous sacrum. Adair also states that the development of the segments of the sacrum and coccyx is atypical and shows considerable variation from the usual or normal type. The variation is mostly in the costal and neural segments.

After the cartilaginous stage, the primary ossification centers appear. At birth, there are usually visible five median centers for the sacral bodies, five paired centers for the neural arches, and usually three pairs of nuclei for the upper three costal processes. The other sacral centers appear after birth. These ossification centers gradually enlarge and eventually fuse. Fusion of the sacral vertebrae begins about puberty at the base of the sacrum and extends upward, becoming complete about the twenty-fifth year. The lateral parts of the sacrum with their sacral tuberosities are derived from all the sacral transverse processes and from the costal processes of the upper three sacral segments. The articular surfaces are formed mostly by the first sacral segment.

The case presented here represents an arrest of development of the centers for the right first and second sacral transverse processes. It is possible that this may be due at least in part to their anomalous relation to the ilium, with lack of bone stimulation, resulting from the absence of weight-bearing pressure against the sacral ala.

The associated congenital club-foot serves to emphasize again the tendency for congenital anomalies to occur in multiple locations.

The distortion of the right hip with the obliquity of the acetabulum presents an additional anomaly, resembling the structural changes associated with congenital dislocation of the hip. The frequent association of spina bifida occulta or manifesta with club-foot has been repeatedly noted, and the importance of complete careful examination cannot be overstressed. If congenital anomalies are carefully looked for and discovered in early infancy, much future disability to the patient and embarrassment to the physician might be prevented.

The features in which the pelvis in this case differs from the pelvis of Nägele are the following: In the pelvis of Nägele, according to Williams, the iliac crest on the affected side is elevated, and there is a definite articulation between the ilium and the defective sacral ala; usually the sacro-iliac joint is ankylosed. There is no suggestion of congenital elevation of the ilium. In this case it is probable that the disability of the right lower extremity contributed to the pelvic deformity. However, the congenital maldevelopment is so clearly demonstrated that it must be assumed to be the most important factor in the production of the deformity.

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# AVULSION OF TENDON OF ATTACHMENT OF BICEPS BRACHII

## A CASE REPORT

BY S. PERRY ROGERS, M.D., CHICAGO, ILLINOIS

Traumatic avulsion of the tendon of attachment of the biceps brachii is sufficiently rare (less than forty cases have been found in the literature) to justify the following case report.

J. S., male, aged forty, of Scandinavian extraction, a shop foreman, on July 1, 1938, sustained an avulsion of the tendon of the biceps brachii, as the result of violent muscle action.

The past history is interesting and pertinent. In his youth, the patient had been a professional acrobat—a wrestler and a tumbler. In 1924, he had been forced to stop performing because of recurrent dislocation of the left shoulder, which appeared to have healed spontaneously, as he had had no trouble for twelve years. During the ten years previous to the tendon injury, he had done no heavy work or strenuous exercise, yet he appeared to have the remarkable muscular development of an athlete.

On July 1, the patient went to the assistance of a fellow workman, who was lifting a 450-pound die from an elevator to a dolly. When the other's hold relaxed, the patient slipped the lower third of his left forearm beneath the die and momentarily sustained most of its weight thereon. As he set the weight down, he felt something in the front of his elbow "tear slowly like tearing a piece of rag".

Examination on the following day showed little pain or tenderness, slight swelling and ecchymosis on the anterior aspect of the elbow, and no limitation of motion. On active flexion, the belly of the left biceps brachii rode one inch higher than that of the right, and the tendon of insertion could not be palpated. The forearm could be supinated, and the elbow could be flexed against gravity, but neither motion could be performed against strong resistance, as compared to the sound side.

Operation was performed twenty-four hours after injury, through a curved incision running down the lateral border of the biceps brachii and across the front of the forearm to a point one and one-half inches below the flexion crease. The bulbous tip of the biceps tendon was found retracted to the junction of the middle and lower thirds of the arm. The tendon was somewhat frayed in the direction of its fibers, but all of its fibers were united at its tip. Access to the radial tubercle was obtained by blunt dissection, with the elbow kept flexed throughout. A drill hole was placed through the tubercle, with the forearm in full supination, and a double suture of heavy braided silk was introduced by means of an aneurysm needle, and divided. Each of the two sutures was mattresssed through the terminal half inch of the tendon and tied down to the tubercle separately. Closure was made with fine plain catgut inside and interrupted silk in the skin. A plaster body jacket and shoulder spica, extending to the finger tips, were applied, with the shoulder flexed at 30 degrees, the elbow flexed at 100 degrees, and the forearm in a position of about two-thirds supination.

The plaster was removed in three weeks, and a bracelet-and-collar sling, gradually lengthened, was worn for three more weeks. The patient returned to his work as a foreman three and one-half weeks after the injury. Gripping exercises for the hand were begun early, and guarded active motion of the elbow was encouraged even before the sling was discarded. Examination, six weeks after injury, showed free shoulder motion, a 10-degree limitation of elbow extension and of forearm supination, and full function of the hand and wrist. Twelve weeks after injury, the patient had full return of function and no atrophy.

## ANKLE DISLOCATIONS WITHOUT FRACTURE

BY MILTON J. WILSON, M.D., F.A.C.S., ARTHUR A. MICHELE, M.D., AND  
EDWIN W. JACOBSON, M.D., NEW YORK, N. Y.

*From the Department of Orthopaedics and Fractures \*, New York Medical College and Flower-Fifth Avenue Hospital; and the Metropolitan Hospital, New York*

Dislocations of the ankle uncomplicated by fracture are rare. Fourteen such cases have been reported in the literature since 1913. The few cases reported prior to that date are unsupported by roentgenographic evidence. The authors have treated two such cases, of which only one of each type has been previously reported.

CASE 1. M. L., white, male, aged thirty-five, married, a cook, was admitted to the Metropolitan Hospital on January 13, 1938, with a history of having fallen a distance of twelve feet down an open elevator shaft. The patient complained of immediate disability and deformity of the right foot.

On admission, the foot was fixed in equinus and displaced backward. There was prominent anterior projection of the lower part of the tibia. No crepitus was elicited in the region of the ankle. The diagnosis of posterior dislocation of the ankle was obvious, and was later confirmed roentgenographically.



FIG. 1-A

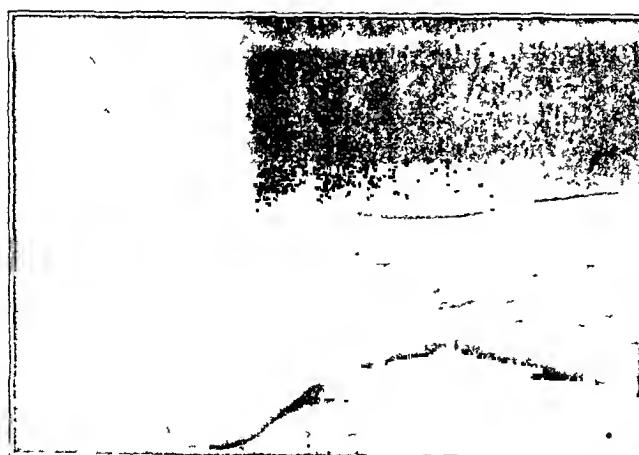


FIG. 1-B

Case 1. Anterior and lateral views of posterior dislocation of the ankle.

\* Anson H. Bingham, M.D., F.A.C.S., Director.

The patient was dis-

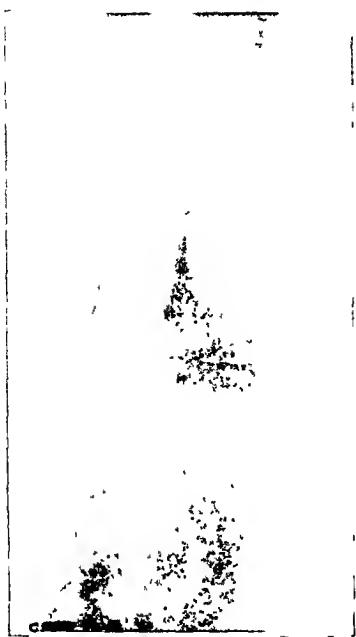


FIG. 2-A



FIG. 2-B

Case 1. Anteroposterior and lateral views of posterior dislocation of the ankle. Note prominence of the tibial extremity.

charged two days later and was treated by another surgeon. The cast was removed after five weeks, and physiotherapy was instituted. Slight weight-bearing was then permitted for two weeks, and full weight-bearing in three weeks, at which time the crutches were



FIG. 3-A



FIG. 3-B

Case 1. Anteroposterior and lateral views of posterior dislocation of the ankle following reduction.

discarded. The patient returned to his normal occupation eleven weeks after the injury, with a good functional result.

Posterior dislocation usually results from a fall forward with the foot plantar-flexed in a neutral position. The force of the body weight is transmitted through the tibia downward and forward over the trochlear surface of the astragalus onto the superior surface of the neck of the astragalus and the navicular. Both the anterior and the tibiofibular ligaments of the ankle joint are torn.

The characteristic signs are the anterior prominence of the lower transverse end of the tibia and outward rotation of the foot. The heel stands out more than usual, while the foot itself appears shortened. The concavity of the Achilles tendon is accentuated. Spasm of the gastrocnemius and soleus muscles tenses the Achilles tendon and fixes the foot in equinus. The inferior anterior surface of the tibia may be palpated easily, and the overlying skin is abnormally tense. The pulsations of the dorsalis pedis and the posterior tibial vessels are easily palpable.

Roentgenographic examination reveals a posterior displacement of the astragalus and the fibula, with the tibia resting on the neck of the astragalus and the navicular.

**CASE 2.** L. S., white, female, aged forty-four, a housewife, was admitted to the Metropolitan Hospital on March 4, 1938, with the history of having fallen downstairs three hours previously during an epileptic seizure. She was unable to stand on the left foot.

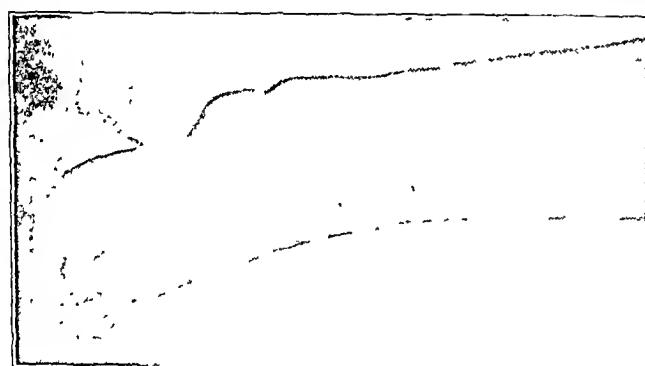


FIG. 4-A

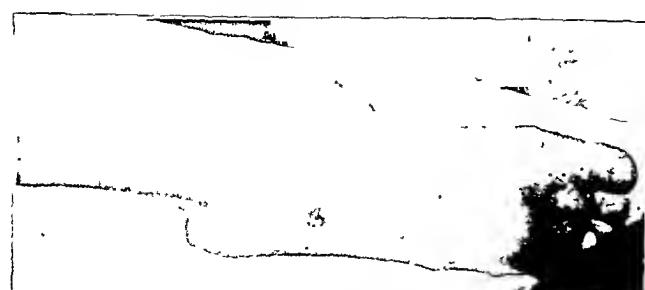


FIG. 4-B

Case 2. Anterior and posterior views of upward dislocation of the ankle.

On admission, the left foot was found to be completely everted upon the ankle with the fibula pivoted by the anterior dislocation of the tibia. There was hyperextension of the everted foot in a flexed position, with no motion in the ankle joint. The ankle mortise was widened. No crepitus was elicited.

The past history was not remarkable, except for epileptic attacks from the age of fourteen to the age of twenty-two, when the patient was married. After two years, she had had another seizure, but there had been none thereafter until the present episode.

Roentgenographic examination, shortly after admission, revealed complete separation of the left tibia and fibula with upward wedging effect of the



FIG. 5-A



FIG. 5-B

Case 2. Anterior and lateral views of upward dislocation of the ankle. Note widening of the mortise.

astragalus. There was overriding of over one inch in both tibia and fibula. Traction was applied under morphine sedation with the foot in inversion, while counter-traction was applied to the thigh, with the knee flexed. When a loud click was heard, reduction was complete. The entire procedure was accomplished within thirty seconds. A circular cast was applied from the knee to the toes, with the foot in slight inversion and at a right angle. Post-reduction roentgenograms revealed an excellent result. After six weeks, the cast was bivalved, and the patient received whirlpool baths for one week more. A tight circular cast was applied from the knee down to the ankle joint. Later roentgenograms showed the bones to be in good position with no widening of the mortise. After a total of ten weeks in the cast, the patient was ambulatory with a good functional result. An ankle brace was prescribed routinely to prevent lateral motion.



FIG. 6-A



FIG. 6-B

Case 2. Anterior and lateral views of upward dislocation of the ankle following reduction. Note complete normal realignment of the bones.

Upward dislocation of the ankle is a compression injury, resulting from a fall upon the foot, usually from a great height. It consists of a complete diastasis of the tibiofibular and interosseous ligaments, with upward displacement of the astragalus between the lateral malleolus and the tibia.

The diagnosis is made on the abnormal broadening of the ankle with approximation of the heel to the malleoli, which are nearly on a level with the plantar surface of the foot. The foot itself is flattened, and absolute rigidity is present.

Roentgenographic examination reveals an upward dislocation of the astragalus with diastasis of the distal tibiofibular articulation.

Treatment of dislocations of the ankle follows a common pattern, with minute variations. For both the posterior and the upward dislocations, traction is applied directly downward on the heel to bring the convex surface of the astragalus to the level of its articulating surface with the tibia. In the upward dislocation, this suffices for a complete reduction; but in the posterior dislocation, dorsiflexion is added to complete the reduction. The Achilles tendon is relaxed by flexion of the knee, thus facilitating the reduction. The diastasis of the tibiofibular joint is the crux of the problem of treatment. In order to secure a satisfactory end result, the fibula must be placed and maintained in close approximation to the tibia for a period sufficiently long to allow complete healing of the ligaments. Early mobilization or weight-bearing will jeopardize firm union of the ligaments, and will result in a widening of the ankle mortise. The latter condition must be avoided in all fractures or dislocations of the ankle.

The necessity for using anaesthesia depends upon the cooperation of the patient and the period of time which has elapsed since the injury. Since our cases were seen within a short time after injury, anaesthesia was unnecessary.

Table I lists the cases of dislocation without fracture which have been reported in the literature since 1913, plus the two which the authors are reporting. Seventy-five per cent. of the cases fall into the age groups between twenty and forty-five years. Sixty-three per cent. of the cases are of the lateral and medial types of dislocation. The anterior, posterior, and upward dislocations occur with equal frequency. Eight of the sixteen dislocations were compound. In one-half of the cases good functional results are reported.

#### SUMMARY

1. In the rare cases of uncomplicated dislocations of the ankle, such as the two reported, the etiology is direct or indirect trauma to the foot.
2. The diagnosis is easily made by clinical examination, while fracture is ruled out by roentgenographic examination.
3. Treatment consists of downward traction upon the heel, with the knee flexed. Dorsiflexion is added to correct posterior displacement.

SUMMARY OF CASES OF ANKLE DISLOCATION REPORTED SINCE 1910

Author	Sex	Age (in years)	Type	Simple or Compound	Etiology	Reduction	Treatment	Weight- bearing	Results
Péaire, 1913	Male	37	Lateral	Compound	Foot struck against a stone	Open	?	?	?
Gillen, 1916	Female	73	Medial	Compound	Fall down stairs	Open	Plaster cast	Five weeks	Good
Green, 1918	Female	25	Medial	Compound	Forelble twist- ing of foot	Open	?	?	?
Milliken, 1918	Male	38	Upward	Simple	Fall from height	Closed	Plaster cast	Four weeks	Fair
Pedlow, 1929	Male	28	Medial	Compound	Automobile accident	Open	Metal splint	Eight weeks	Good
Seharsich, 1931	Male	17	Anterolateral	Simple	Fall from tree	Steinmann pin on Kocher apparatus	Traction	?	?
Seharsich, 1931	Female	21	Anterolateral	Simple	Forelble twist- ing of foot	Closed	?	?	?
Hirschfield, 1932	Male	52	Lateral	?	Fall down stairs	Open; Kocher re-ecction	Plaster cast	Three weeks	Good
Dehne, 1933	Female	19	Lateral	Simple	Repeated trauma	Closed	Plaster cast	First day	Fair
Pegreff, 1934	Male	36	Lateral	Compound	Fall from height	Open	Plaster cast with window	Eight weeks	Good
Aboulker and Herbert, 1935	Male	22	Medial	Compound	Automobile accident	Closed	Plaster cast	?	?
Conwell and All- dredge, 1937	Male	40	Medial	Compound	Railroad accident	Open	Plaster cast	Six weeks	Good
Sloane and Coutis, 1937	Male	40	Posterior	Simple	Foot caught in wire noose under tension	Closed	Sugar-tong and posterior splint; later Unna boot	Five weeks	Good
North, 1938	Female	42	Lateral	Compound	Fall down stair	Open	Plaster cast	Four weeks	Good
Wilson, Michele, and Jacobson, 1939	Male	35	Posterior	Simple	Fall from height	Closed	Plaster cast	Ten weeks	Good
Wilson, Michele, and Jacobson, 1939	Female	44	Upward	Simple	Fall down stairs	Closed	Plaster cast	Ten weeks	Good

Reduction becomes evident as the bone clicks sharply into place, and a normal range of ankle motion is obtained. Reduction is easily accomplished without anaesthesia.

4. In posterior and upward dislocations, the ankle is immobilized in a plaster cast for ten weeks, followed by whirlpool baths.

5. Good functional results were obtained in our cases by the method described. Operative procedures were found unnecessary.

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# COMPOUND DISLOCATION OF THE TIBIOTALAR JOINT WITHOUT FRACTURE AND WITHOUT SEPARATION

BY CHARLES HAINES, M.D., NEW YORK, N. Y.

According to Conwell and Alldredge, a complete compound dislocation of the tibiotalar joint without fracture and without separation of the tibiofibular joint is rare. They reported such a case in the *Journal of the American Medical Association* (Vol. CVIII, p. 2035, July 12, 1937). In the course of their report, appears the following quotation from Böhler: "A lateral dislocation of the ankle without a fracture of one or both of the malleoli is possible only when the joint between the tibia and fibula is broken."

The following case, treated by the author, is similar to that reported by Conwell and Alldredge.

H. K., white, male, forty-two years of age, a chauffeur, was struck and knocked down by the heavy bucket of a steam shovel. He was seen by the writer soon after the accident. There was an extensive wound on the lateral aspect of the left ankle with maceration and tearing of the soft parts. The distal ends of the tibia and fibula protruded through this wound for a distance of approximately ten centimeters. The foot lay at a right angle to the leg, the plantar surface facing medially. The articular surface of the astragalus was entirely exposed. All of the joint surfaces had fine sand ground into them. There was no separation of the tibiofibular joint, nor was there any fracture.

The patient was immediately taken to the operating room, where, under a general anaesthetic, the joint surfaces were washed with normal saline and the sand was removed. The wound was thoroughly débrided, but no chemical disinfectant was used in it. The dislocation of the foot on the leg was reduced. The ligaments on the lateral aspect of the joint were reconstructed with plain catgut sutures. The fascia and skin were closed without drainage. The extremity was then placed in a posterior molded plaster-of-Paris splint.

The rectal temperature reached a maximum of 100.6 degrees on the second day after the accident. Thereafter it gradually receded, reaching normal on the eleventh day. It remained normal throughout the remainder of the patient's stay in the hospital.

The wound healed kindly without infection. The sutures were removed on the seventeenth day after operation. At this time, the wound seemed solid, and there was some motion at the ankle joint. The patient was up and about the ward on crutches. The leg and foot were still held at a right angle by the posterior splint.

The patient was discharged from the hospital on the seventy-fifth day after the accident. At this time, examination showed moderate swelling of the foot, ankle, and distal half of the leg. There was no pain in the ankle, except when the patient bore weight on the foot. Motion at the ankle joint was limited to 10 degrees of flexion and 20 degrees of extension. There was neither inversion nor eversion.

The patient was allowed gradually to bear normal weight on the foot, using first one crutch and then a cane. He was encouraged to exercise the ankle. Motion at the ankle gradually increased, so that six months after the accident flexion and extension were practically normal. Inversion and eversion were slight.

When last seen, a year after the accident, the patient had a useful foot. He was able to walk without pain and to work as a chauffeur. Flexion and extension were practically normal, and there was enough inversion and eversion, so that he could walk on uneven ground with comparative comfort and safety.

# AVULSION OF THE ANTERIOR SUPERIOR SPINE OF THE ILIUM

## A CASE REPORT

BY LESLIE V. RUSH, M.D., AND H. LOWRY RUSH, M.D.,  
MERIDIAN, MISSISSIPPI

Avulsion of the anterior superior spine of the ilium usually occurs in young athletes before the age of ossification of the epiphysis and is the result of violent muscle pull during strenuous exercise. In the following case, it occurred during a game of football.

W. M., a white male, aged seventeen years, entered Rush's Infirmary on November 13, 1937, eighteen hours after receiving an injury to the region of the right hip. The patient had felt sharp twinges of pain in the region of the anterior superior spine occurring at intervals for several days, but had suffered no disability. During a game of football, he was running for a touchdown when he was suddenly seized by a violent pain in the region of the anterior portion of the hip, and he fell to the ground. It was necessary to carry him from the field. Motion of the hip was limited in all directions by pain anterior to the hip. There was moderate swelling in the region of and below the right anterior superior iliae spine, which prevented accurate palpation of the bone. Anteroposterior roentgenograms revealed that the anterior superior spine of the right ilium was avulsed and displaced downward about one and one-half inches.

At operation, a three-inch curvilinear incision was made, beginning at the crest of the

ilium and passing anteriorly and downward just lateral to the normal position of the anterior superior spine of the ilium. The fragment was exposed and was found to be pulled downward by the action of the sartorius muscle, carrying with it Poupart's ligament. The spine was replaced and fixed to the ilium by a stainless-steel nail. The nail was so placed that the head was situated medial to the incision, and it protruded sufficiently above the bone so that it could be felt through the skin and later could be removed through a skin incision just large enough to admit the head. The torn fascia was sutured with No. 0 chromic catgut. Clips were used for the skin.

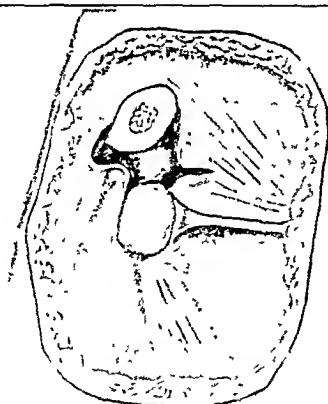


FIG. 1

Mechanism of displacement. The anterior superior spine of the ilium is pulled downward by the sartorius, carrying with it Poupart's ligament.

Flexion of the hip was maintained by a cast applied from the upper third of the thigh to the toes, with the knee flexed 90 degrees. A broom handle, eighteen inches in length, was placed transversely at the heel and incorporated in the plaster to hold the foot in the vertical position. This cast was removed at the end of two weeks. Weight-bearing was permitted in one month. Three weeks after the injury, the nail was removed through a small incision under local analgesia.

The result in this case, both anatomically and functionally, was excellent. The period of disability could, no doubt, have been shortened, as the nail fixation was most adequate, and it is extremely unlikely that separation could have recurred had immediate activity been permitted. Following the internal fixation, the pain of which the patient complained prior to operation was completely relieved.

# CONGENITAL UNILATERAL ABSENCE OF THE MEDIAL SESAMOID OF THE GREAT TOE

## REPORT OF A CASE

BY PAUL W. LAPIDUS, M.D., F.A.C.S., NEW YORK, N. Y.

*From Trinity Hospital\*, Brooklyn*

Pfitzner, in his classic work, *Die Sesambeine des menschlichen Körpers*, stated that the sesamoids of the great toe are constantly present and become well developed, due to preponderant growth of the first ray in the human foot. These bones are apparently the rudimentary parts of the human skeleton.

Inge, in 1936, reported two cases of congenital absence of the medial

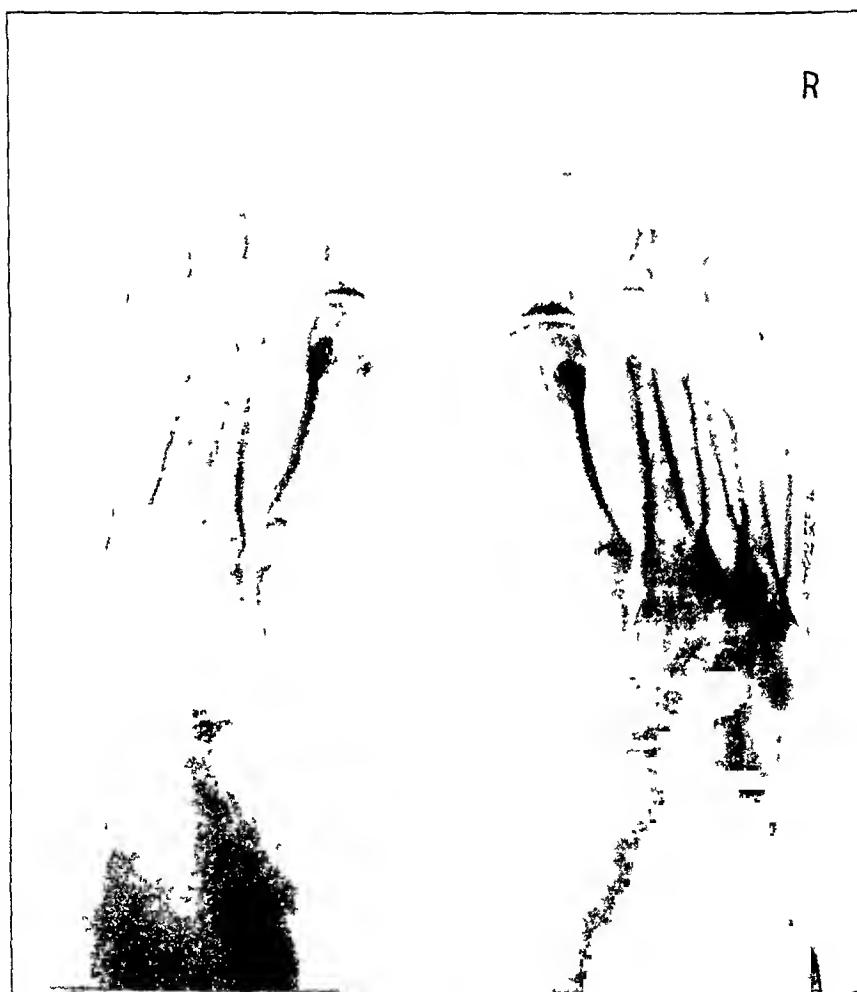


FIG. 1

\* Service of Harry Finkelstein, M.D.

sesamoid of the great toe, and stated that, after an extensive survey of the literature, he had failed to find any reports of similar cases.

The present writer, in a study of 1000 roentgenograms of feet and a painstaking review of the literature on inconstant bones and sesamoids of the foot, has also been unable to find a single case of congenital absence of the medial sesamoid of the great toe. He, therefore, wishes to record another case of this apparently very rare variation in the skeleton of the foot. This case is evidently the third which has been published.

#### CASE REPORT

J. N. (No. 36799), a healthy woman, thirty years old, was seen by the writer at the clinic of Trinity Hospital on May 23, 1935, complaining of weakness and occasional pain in both feet of a number of years' duration. She had been treated in another institution, and had been given metal foot plates. To the best of her recollection, the patient had never had any complaints referable to the right great toe, and no operation had ever been performed upon the right foot.

Examination was essentially negative, except for moderate pronation of both feet, with some depression of the longitudinal arches. Slight tenderness was present over the medial aspect of both navicular bones, which were rather prominent.

The right great toe was entirely normal. There were no scars around the sesamoid region.

Routine roentgenographic examination of the feet revealed the absence of the right medial sesamoid (Fig. 1). Unfortunately, the author was unable to obtain a plantar roentgenogram of the feet (taken with the great toes in dorsiflexion) for more detailed demonstration of the sesamoids.

It is difficult to express any opinion as to the cause of this anomaly in the skeleton of the foot. Probably the cartilaginous center for the right medial sesamoid was present, but, for some reason, the sesamoid failed to ossify.

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## A SLEEVED-WIRE METHOD OF FIXATION OF FRACTURES\*

BY THOMAS WHEELDON, M.D., RICHMOND, VIRGINIA

In certain types of fractures—such as fractures of the lower end of the humerus, the lower end of the femur, the upper end of the tibia, and the lower end of the tibia and fibula, where the fragments tend to separate—it has been the writer's experience that the results obtained have not always been as good as one would desire. This is apparently due to the fact that it is difficult to compress the fragments together and to hold them so compressed.

In the elbow there has been a tendency to gunstock deformity; in the knee, to knock-knee or bow-leg; and in the ankle, to either a valgus or a varus deformity. The writer has tried, with varying success, all the usual methods of treating these cases and has felt that the ideal method had not been designed. The method herein described was first used by him somewhat more than four years ago, and it has been so satisfactory that it is herewith presented.

Originally a small bolt was used. This is illustrated in Figure 1 and is designated by the letter *F*. The component parts used at that time are indicated by the letters *G*, *H*, and *K*. The reader will be able to interpret these component parts from the description of the wire now used.

At present the apparatus employed in the procedure (Fig. 1) consists of a Kirschner wire (*A*), a sleeve for the wire (*D*), in which is incorporated a set screw (*E*), and a tightener (*B*), with a set screw (*C*).

Following roentgenographic examination, the fracture is reduced as completely as possible, and a Kirschner wire is introduced in a suitable manner into the fragments of bone. Ordinarily, this is done under a local anaesthetic. With a sharp knife, a small nick is made on either side of the wire in the skin for a distance of about an eighth of an inch, making the total incision one-quarter of an inch in length. A hemostat or other small blunt instrument is then introduced along the wire, and the tissues are freed immediately around the wire; if possible, the periosteum is lifted up. Two sleeves are then slipped over the ends of the wire, so that they enter the small incisions and pass into the bone. Beyond the sleeves two tighteners are slipped on the ends of the wire. The set screws in the tighteners are then adjusted with a suitable key, so that the tighteners cannot slip off the wire. As each tightener consists of two parts—an outer collar, hexagonal in shape, and a central core, which is smaller in diameter than the sleeves used and which has in its outer end the set screw—compression is obtained by turning the collars with small wrenches in a clockwise manner. Since the outer ends of the tighteners are fixed points (set screws in the cores), the inner ends of the collars engage the outer ends of

\* This research has been carried out under the direction of the Wheeldon Orthopaedic Foundation and its associated Orthopaedic Centers.

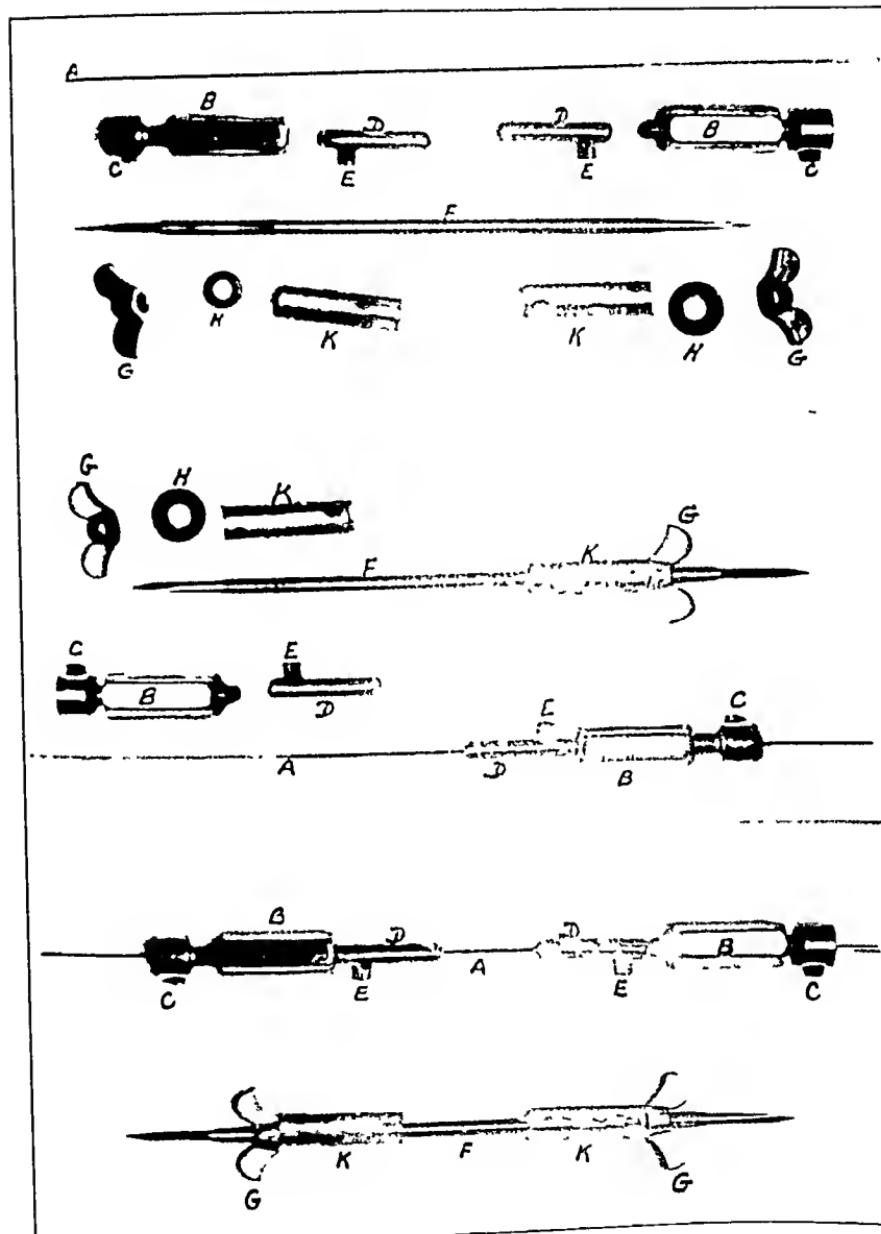


FIG. 1  
Showing details of the apparatus.

the sleeves and move inward, thereby driving the sleeves against the fragments of bone and ultimately the fragments of bone against each other. When the sleeves have engaged the bone securely, the fragments of bone themselves will be compressed together. A tightener is used at each end of the wire, because experience has demonstrated that this ensures better compression, as frequently one fragment of bone moves more freely than the other. When satisfactory compression and reduction have been obtained, as checked by postoperative roentgenograms, the set screws on the ends of the sleeves are tightened, so as to grip the wire and prevent the



FIG. 2-B  
Application of method



FIG. 2-A  
One type of fracture in which method has been used



FIG. 3-A  
Before introduction of wire.

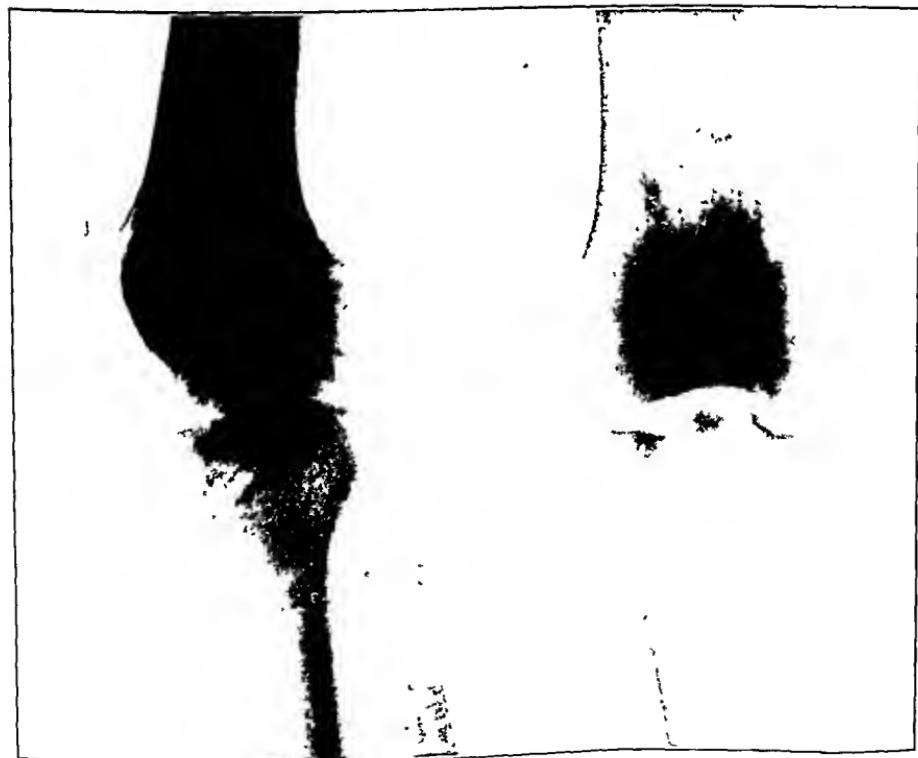


FIG. 3-B  
Showing the end results.

sleeves from slipping outward. The tighteners are then removed, and the ends of the wire are cut off close to the sleeves. This will leave a portion of each sleeve extending beyond the soft tissues.

A dressing moistened with compound tincture of benzoin is then placed evenly around the end of each sleeve and covered with sterile sheet wadding, after which a very light plaster is applied, more for protection of the dressing than for immobilization. The wire is left in place until union has become fairly well established. When this is true, the plaster is removed, the set screw in one sleeve is loosened, and that sleeve is slipped off the end of the wire. When this has been done, the end of the wire is thoroughly sterilized with alcohol and iodine, and the sleeve on the other side of the extremity is gripped, and the wire is pulled out of the extremity. It has been found that, with one sleeved wire alone, it is practically impossible for two people to pull the fragments apart or to dislodge them. In a few cases, to secure proper reduction, it has been necessary to do open operations. The sleeved wires have been introduced at that time and have worked in a very satisfactory manner.

In every case in our series the skin has healed tightly around the sleeve and, on removal of the sleeve and wire, a clean, round aperture, less than a quarter of an inch in diameter, has been present. In our experience, this aperture has closed over within two or three days and has healed completely in less than a week. In a series of forty-four cases of fracture of the upper end of the tibia, no infection or irritation of the soft tissues in any way was found.

Originally, a full-length plaster was applied, but, as experience increased, less plaster was used, and the activity of the joint was started earlier until, at the present time, the period of application of plaster has been reduced in some cases to one week. Both active and passive motion in these joints are started at that time.

In every case the functional result has been considered good: there has been a full range of motion in the joint, with no deformity. The period of convalescence has been reduced materially.

Since this method has been used in the types of cases described, its usefulness has been increased by its application as a fixation procedure in long oblique fractures of the femur and tibia, two sleeved wires being used if necessary.

#### SUMMARY

The sleeved-wire method of fixation of fractures described is efficient in fixation, simple in accomplishment, comfortable to the patient, time-saving in convalescence, and non-irritating to the tissues, and it permits easy removal of the wire. With this method, the writer has been able to obtain better results than with other methods.

# DISLOCATION OF THE HAMATE BONE

## REPORT OF A CASE

BY DONALD C. GEIST, M.D., F.A.C.S., PHILADELPHIA, PENNSYLVANIA

*From the Misericordia Hospital\*, Philadelphia*

Dislocation of the hamate (unciform) bone was first reported by Buchanan in 1882. Six other cases have been reported by Oberst, Ebermayer, Eigenbrodt, van Assen, Murphy, and Johansson. The following case, therefore makes a total of eight.

The patient, a white male, twenty-three years of age, was admitted to Misericordia Hospital, on April 10, 1937. He had fallen from a scaffold to the ground, a distance of three stories, sustaining a fracture of the upper third of the shaft of the right femur; dislocation of the hamate bone of the right hand; fractures of the transverse processes of all of the lumbar vertebrae on the right side; fractures of the sixth, seventh, eighth, ninth, and twelfth ribs on the right side; and multiple contusions and abrasions. For the purpose of the present report, only the injury to the hand will be considered in detail.

The patient complained of a great deal of pain and swelling on the dorsum of the right hand. On examination, the hand was swollen and very tender. Over the dorsum of the hand, near the ulnar side, there was a firm, hard, bony prominence. After subsidence of the swelling, this prominence remained. There

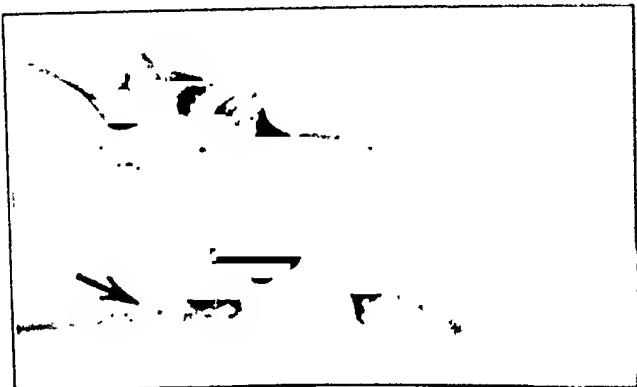


FIG. 1

Lateral view of wrist, showing dislocation of hamate bone.



FIG. 2

Lateral view of wrist, showing reduction of dislocation after operation.

\* Surgical Service of James A. Kelly, M.D.

was marked limitation of motion at the wrist with some restriction of finger motion. Roentgenograms revealed a posterior dislocation of the hamate bone.

On April 28, 1937, closed reduction of the dislocated bone was attempted, but complete reduction could not be secured. On May 3, 1937, after a second attempt at closed reduction, which also failed, a straight incision was made over the hamate, and the bone was found to be partially luxated, so that it was posterior to the proximal ends of the fourth and fifth metacarpals, jutting beyond them. The bone was pried into its proper position and remained there when the hand was placed in slight flexion at the wrist. The incision was closed, and the hand and forearm were enclosed in a plaster-of-Paris sugar-tong splint, with the hand slightly flexed on the wrist. Postoperative roentgenograms showed decided improvement in the position of the bone, and two weeks later demonstrated complete reduction of the dislocated hamate.

The plaster splint was removed four weeks after operation, and active motion, baking, and massage were begun. At discharge, on June 18, 1937, there was moderate motion of the hand and wrist, without pain and with only slight swelling of the back of the hand.

Follow-up examination, on September 18, 1937, showed very slight prominence and swelling over the region of the hamate bone. All motion was normal except for a 10-per-cent. loss of flexion and of extension at the wrist. There was no pain, and the patient stated that he was able to use his hand and forearm normally. A roentgenogram showed complete reduction of the old dislocation of the bone, with slight narrowing of the joint space between the hamate and the metacarpals.

The hamate bone may be dislocated to the volar or dorsal surface of the hand, the latter being the more frequent. The dislocation may be partial or complete. Indirect or direct violence may cause the injury. Ebermayer believes that direct and very violent impact is necessary to cause it. Johansson states that indirect force may be the factor, and adds that marked dorsal flexion of the hand on the wrist will dislocate the bone much as in the mechanism producing dislocation of the lunate bone. In the cases reported by Oberst and Eigenbrodt, the injury was the result of direct impact. The exact mechanism in the case reported by the author could not be determined.

The physical signs of the injury are not numerous. There is con-



FIG. 3

Lateral view of wrist, three months after operation, showing normal position of hamate bone.

siderable pain in the hand with swelling over the dorsum, more marked on the ulnar side and in the region of the distal row of carpal bones. The presence of a bony prominence, either on the volar or dorsal side of the hand, is usually noted. Shortening of the carpus on the ulnar side is evident both clinically and roentgenographically. Frequently, tingling and paresthesia, the result of nerve damage, are noted about the ulnar side of the hand. Complete proof of the injury is secured by the roentgenogram.

The choice of treatment lies between primary extirpation of the bone, operative replacement, and conservative measures. Operation with extirpation of the bone was practised by Murphy, Eigenbrodt, and Johansson, and the end results were good. Ebermayer was forced by his patient to use conservative measures, with a poor result. In the remainder of the reported cases there was no discussion of the method of treatment. The author, in the case reported, made several unsuccessful attempts at closed reduction. Open operation was then done, with replacement of the bone. The end result was very good, with excellent function of the hand.

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## AVULSION FRACTURE OF THE OS CALCIS \*

BY ABRAHAM S. ROTHBERG, M.D., NEW YORK, N. Y.

*From the Hospital for Joint Diseases †*

The purpose of this report is to emphasize the comparative rarity of avulsion fracture of the os calcis, the importance of early diagnosis, and the necessity for instituting treatment in order to avoid subsequent complications.

Several series of cases of fracture of the os calcis have been published and approximately only one fracture in eighty is of the avulsion type. The diagnostic files of the Hospital for Joint Diseases revealed thirty-nine fractures of the os calcis with but one of the avulsion type.

These fractures are produced by falls in which the individual lands on the feet with stiff knees, or muscle pull or torsion may result in avulsion.

Too frequently these cases go undiagnosed, and the patients are treated for ankle sprains without resort to roentgenographic confirmation. Patients inadequately treated may later complain of stiffness, pain, and swelling at the insertion of the tendo achillis, and inability to rise on the toes of the affected side. In cases in which there is slight separation of the fragments, immobilization in equinus is required. If there is considerable separation of the fragments, open correction is advisable. This procedure was employed in the following case.

### CASE REPORT

A woman, aged sixty, while alighting from a bus on November 19, 1936, slipped and fell with her full weight on the right lower extremity. She managed to walk home unassisted, a distance of one block. Her physician diagnosed the injury as a sprained ankle and applied adhesive plaster to the right ankle and foot. The following day a roentgenogram (Fig. 1) revealed the presence of an avulsion fracture, and the patient was referred to the author.

Examination disclosed a swelling about the right heel with marked tenderness over the upper border of the os calcis. Dorsiflexion was very painful and active plantar flexion was impossible; standing on tiptoe was not even attempted.

On November 21, 1936, an open operation was performed; a posterolateral incision was necessary because of a superficial adhesive-plaster irritation. After the intervening blood clot was removed, two drill holes were inserted into the avulsed fragment and the body of the os calcis, and they were approximated with strong kangaroo tendon. With the knee flexed at 100 degrees and the foot in complete equinus, a circular plaster-of-Paris dressing was applied from the mid-thigh to the toes.

There was no postoperative rise in temperature. On removal of the cast four weeks later, a superficial infection was noted. A new cast was applied up to the knee with the foot in a position of less equinus; this cast was worn for an additional four weeks. The patient was then permitted to bear weight.

At the time of the follow-up examination four months later, the patient was walking without pain or a limp. She could stand on tiptoe and maintain that position without

\* Presented at the Orthopaedic Departmental Conference, March 15, 1938.

† Service of Harry Finkelstein, M.D.

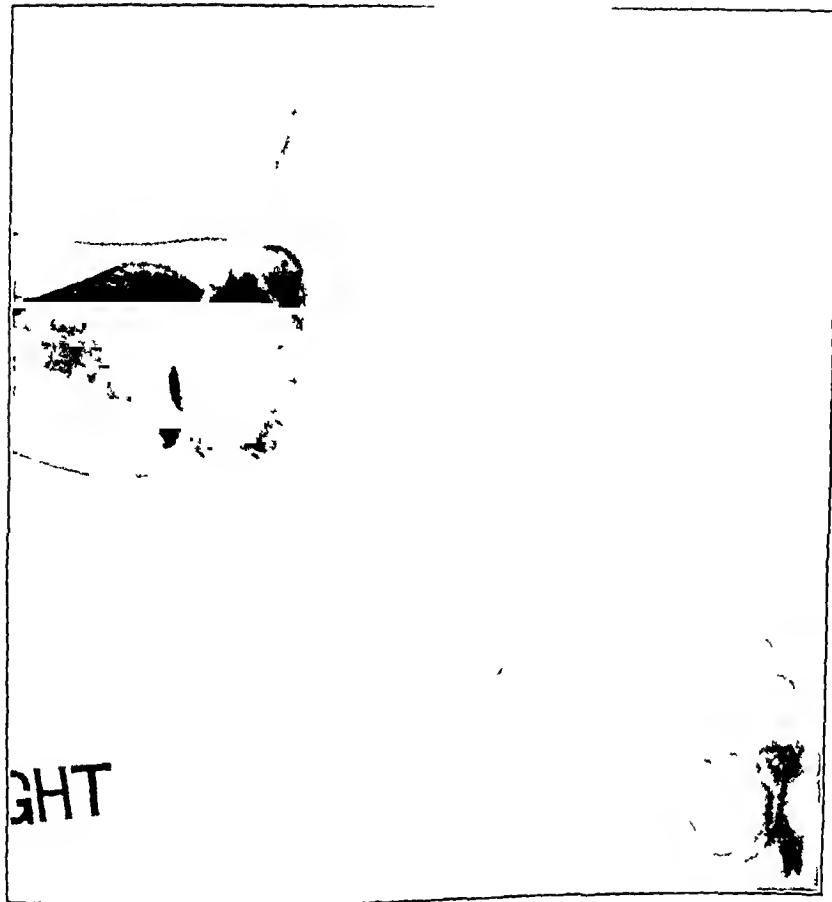


Fig. 2  
Ten months after operation.



Fig. 1  
Avulsion fracture of the os calcis

difficulty. There was no restriction of motion in any direction. Figure 2 shows the roentgenogram taken ten months after operation.

#### CONCLUSION

In the case of fracture of the os calcis due to contraction of the muscles which has been described, although infection set in at the operative site, the patient made a complete recovery. She is able to walk considerable distances even though the tendo achillis was not lengthened.

## A SERVICEABLE GONIOMETER WITH SUPINATION-PRONATION ATTACHMENT

BY HERBERT W. VIRGIN, M.D., MADISON, WISCONSIN

During the past two years the writer has used his own goniometer with such success and satisfaction that he feels justified in reporting it. Figure 1 shows a new goniometer of serviceable design, which has wide application in the measurement of articular joints. It is light, inexpensive, with easily readable figures, and it can be made in the surgeon's own workshop with a hand saw, from a scrap or two of eight-gage aluminum, a ten-cent protractor, a small steel rod, a nut and bolt, etc.

Following are listed some of the joint motions which can be measured with this instrument because of its design. Some of these measurements the writer has not been able to obtain as accurately or as easily with other instruments.

1. Abduction and adduction of the lower extremities (Fig. 2). These movements are accomplished by placing the long arms of the instrument upon the anterior superior spines of the ilium (marked on the skin with black in Figure 2) and then centering the protractor over the acetabulum at a point halfway between the symphysis pubis and the greater trochanter as viewed anteriorly. The moveable arm is placed in the long axis of the limb and moved with it.

2. Rotation of the head and neck. This is measured in either of two ways: (a) by seating the patient, placing the protractor over the head, and, by looking downward, lining up the long arms of the instrument with the acromial processes; or (b) by placing the patient on his back and lining up the long arms of the instrument parallel to the table surface. The

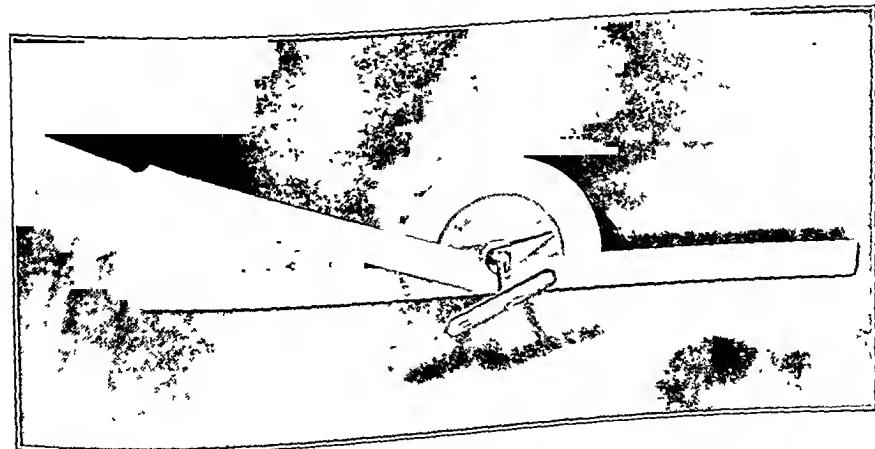


FIG. 1

The author's goniometer, with supination-pronation attachment.



second and third fingers. The indicator end is inserted into the hole at the center of the protractor. The figures at the right of 90 degrees indicate the supination, and those at the left of 90 degrees, the pronation.

6. Internal and external rotation of the thigh. While this measurement is being taken, the patient is seated on the table edge, with the feet hanging. The long arms of the instrument are lined up parallel to the surface of the table, with the moveable arm parallel to the axis of the leg. The leg is swung manually for passive motion or actively by the patient to extremes of motion for accurate reading.

Other useful features will be discovered upon examination of the instrument. The writer finds it most valuable not only in the field of compensation work and legal medicine, where an accurate knowledge of joint motion is essential, but also in the many phases of treating old and new fracture cases. Of special interest is the fact that, during the after-treatment of a fracture case, such an instrument enables the surgeon to demonstrate to the patient his day-to-day progress in acquiring motion.

## News Notes

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The Eighth Walter M. Brickner Lecture was given at the Hospital for Joint Diseases on Thursday evening, November 17, 1938, by Dr. Charles A. Elsberg of New York City. The subject of the lecture was "The Orthopedic and Neurological Significance of Notalgia (Back Pain)".

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Dr. Jesse T. Nicholson has moved his office from 1726 Spruce Street to 1614 Locust Street, Philadelphia, Pennsylvania.

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Dr. David Sashin has moved his office from 51 West 86th Street to 25 West 81st Street, New York, N. Y.

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Dr. John White McCammon announces the removal of his offices to 811 Doctors Building, Cincinnati, Ohio.

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Dr. H. M. Hurwitz has moved his office from 242 Trumbull Street to 75 Pearl Street, Hartford, Connecticut.

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Dr. Maurice H. Herzmark announces the removal of his office to 116 East 58th Street, New York, N. Y.

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The Twentieth Annual Meeting of the Société Française d'Orthopédie et de Traumatologie was held in Paris on October 21, 1938. The following subjects were discussed:

Osteoporosis and Malacia of the Spine in Adults—Dr. Marcel Lance, Dr. Pierre Lance, and Dr. Decourt, all of Paris.

Simultaneous Fractures of the Diaphyses of Both Bones of the Forearm—Dr. Boppe, of Paris, and Dr. Billet, of Lille.

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At a recent meeting of the Executive Committee of the British Orthopaedic Association, the following orthopaedic surgeons were elected to Associate Membership:

Mr. A. N. Birkett, General Hospital, Nottingham.

Mr. M. Dockrell, Manfield Orthopaedic Hospital, Northampton.

Mr. G. S. Evans, Heatherwood Hospital, Ascot.

Mr. J. C. R. Hindenah, 59 Harley Street, London, W. 1.

Mr. D. M. Keir, 113 St. Alban's Road, Edinburgh, Scotland.

Mr. A. M. Keith, St. Congans Den, Turriff, Aberdeenshire, Scotland.

Mr. M. B. Khan, 5 Moorland Road, Hyde Park, Leeds, 6.

Mr. J. H. Mayer, Guy's Hospital, London, S. E. 1.

Mr. J. F. H. Stallman, 55 Barton Street, Gloucester.

Mr. G. M. Thompson, Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry.

At the last meeting of the **Société Belge d'Orthopédie** on November 19, 1938, the following officers were elected:

President: Dr. Jean Verhingge  
First Vice-President: Prof. Parisel  
Second Vice-President: Dr. P. Lorthiør  
Secretary: Dr. Kempeneers  
Dr. Poneelet  
Treasurer: Dr. Goffin.

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The Fourth Annual Postgraduate Institute of the **Philadelphia County Medical Society** will be held in the Bellevue-Stratford Hotel, Philadelphia, Pennsylvania, during the week beginning March 13, 1939. The subjects to be considered are "Blood Dyscrasias" and "Metabolic Disorders". These will be further subdivided for convenience in instruction into eighty-six clinical lectures, with open-forum discussion for each topic, delivered by as many individual specialists of national distinction. Further information in regard to this Institute may be obtained from the Philadelphia County Medical Society, Twenty-First and Spruce Streets, Philadelphia, Pennsylvania.

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The **Mississippi Valley Medical Society** offers a cash prize of \$100, a gold medal, and a certificate of award for the best unpublished essay on a subject of interest and practical value to the general practitioner of medicine. Entrants must be members of the American Medical Association. The winner will be invited to present his contribution before the next annual meeting of the Mississippi Valley Medical Society at Burlington, Iowa, September 27, 28, and 29, 1939. The Society reserves the exclusive right to publish the essay in its official publication, the *Mississippi Valley Medical Journal*. Contributions must not exceed 5000 words, must be typewritten in English in manuscript form, must be submitted in five copies, and must be received not later than May 1, 1939. Further details may be secured from Dr. Harold Swanberg, Secretary, Mississippi Valley Medical Society, 209-224 W. C. U. Building, Quincy, Illinois.

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At the Annual Meeting of the **Orthopaedic Guild**, held in Toronto, Canada, November 25 and 26, 1938, under the chairmanship of Dr. W. A. Farmer, the following papers were presented:

Cases of Slipped Epiphysis—Dr. J. Roberts  
Congenital Dislocation of the Hip—Dr. W. S. Keith.  
Free Skin Graft—Dr. A. W. Farmer.  
Legg's Disease—Dr. R. M. Wansborough.  
Sympathectomy for Leg Lengthening—Dr. J. M. McDonald.  
Seoliosis—Dr. A. B. LeMesurier.  
Bone Tuberculosis—Dr. R. I. Harris.  
Ulcers of the Leg—Dr. S. D. Gordon.  
Fat Embolism—Dr. R. I. Harris.  
Stokes-Gritti Amputation—Dr. D. W. G. Murray.  
Fractures of the Os Calcis—Dr. J. A. McFarlane.  
Non-Union of Fractures of the Femoral Neck—Dr. F. I. Lewis.  
Tenodesis for Calcaneus Deformity—Dr. W. E. Gallie.

The next meeting will be held in Cleveland on December 1 and 2, 1939, under the chairmanship of Dr. J. I. Kendrick.

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The initial meeting of **The Portland Orthopaedic Club** was held in Portland, Oregon, on October 21, 1938. The charter members consist of those practitioners in

Portland who confine their practice to orthopaedic surgery. A prerequisite for membership in this society from now on is that the candidate be a diplomate of the American Board of Orthopaedic Surgery. Scientific meetings will be held each month. Dr. Otis F. Akin was elected President and Dr. A. Gurney Kimberley, Secretary for the ensuing year.

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The Sixteenth Annual Meeting and Scientific Session of the Academy of Physical Medicine was held at the Willard Hotel, Washington, D. C., on October 24, 25, and 26, 1938, under the presidency of Dr. Rolland A. Case of Cleveland, Ohio, who was elected President following the death of Dr. R. Tait McKenzie. The very full and varied program included papers by many well-known surgeons. Of especial interest to orthopaedic surgeons were the following:

Treatment of Poliomyelitis during the Post-Paralytic Stage—Dr. Allen F. Voshell, Baltimore, Maryland.

Surgical Lengthening of the Top of the Femur in Anterior Poliomyelitis—Dr. Fred H. Albee, New York, N. Y.

Treatment of Anterior Poliomyelitis Based on Present Knowledge—Dr. LeRoy W. Hubbard, New York, N. Y.

The Structure of the Spine, Including the Costovertebral Joints with Reference to Function—Dr. Joel E. Goldthwait, Boston, Massachusetts.

The Rôle of the Hamstrings in the Production of Faulty Posture—Dr. Thomas F. Wheeldon, Richmond, Virginia.

Some Aspects of Bursitis of the Shoulder—Dr. Gordon Mackay Morrison and Dr. William D. McFee, Boston, Massachusetts.

At the Public Session on the evening of October 24, Dr. William D. McFee, of Boston, read an Appreciation of Dr. McKenzie, the former President of the Academy, who had accomplished so much in the field of Physical Therapy. Through the courtesy of Mrs. McKenzie, the members and guests were given the opportunity of viewing some of the rare bronzes done by Dr. McKenzie.

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#### BRITISH ORTHOPAEDIC ASSOCIATION

The Annual Meeting of the British Orthopaedic Association was held in Birmingham on October 21 and 22 under the Presidency of Mr. Naughton Dunn. A large number of members attended and enjoyed not only most stimulating scientific sessions, but also a tour of the impressive new Hospital Centre and Medical School, conducted by the Dean of the Medical Faculty, Dr. Stanley Barnes. The Association Dinner was held at the Midland Hotel, and the guests included many distinguished members of Birmingham University.

A Clinical Demonstration was given in the Out-Patient Department of the Royal Cripples' Hospital. A large number of patients were shown, demonstrating the end results of various orthopaedic procedures. The demonstrators included Mr. Naughton Dunn, Mr. Percival Mills, Mr. J. B. Leather, Mr. Wilson Stewart, Mr. F. G. Allan, Mr. A. G. Hendry, Mr. T. S. Donovan, and Mr. H. Donovan.

A series of papers were read, the résumés of which follow:

##### *Coxa Plana* by Mr. H. Jackson Burrows, London

This contribution was a most clear and interesting epitome of the essay for which Mr. Burrows had been awarded earlier this year the Robert Jones Medal and Prize of the Association.

Mr. Burrows dealt chiefly with the pathology of the condition and its relationship to similar lesions of other bones and to proved aseptic necrosis of bone. He described the essential histology of coxa plana as: (1) an atypical subchondral necrosis, which involves lysis of trabeculae; and (2) an ingrowth of phagocytic and reparative young mesodermal

tissue. The roentgenographic criterion was destruction of trabeculae. Coxa plana could not be regarded as being due to complete arterial obstruction, for, in lesions resulting from the latter (for example, aseptic necrosis of the femoral head following subcapital fractures), the normal architecture and texture of the bony trabeculae are preserved for a long time. Mr. Burrows discussed the experimental work which he had carried out in trying to determine the pathogenesis of coxa plana. Arterial obstruction alone did not produce the typical changes, and he felt, although he had been unable to prove it, that venous obstruction and/or hemorrhage into the bony nucleus of the femoral head might play an important rôle. Infection, although unlikely, could not be ruled out entirely as a causal factor.

#### *Bone Lengthening by Mr. F. G. Allen, Birmingham*

Mr. Allen described in detail the method which he employs for leg lengthening, with the indications for this procedure and the precautions which must be observed if ectasias are to be avoided. From an analysis of the large series of patients on whom he had performed lengthening operations he concluded that lengthening of two inches can be safely and easily obtained, that tibial lengthening is more certain and easier to control than femoral lengthening, and that many of the complications experienced by other surgeons are due to extensive and unnecessary stripping of the periosteum and damage to the soft tissues.

#### *An Operation for Calcaneocavus by Mr. Bryan McFarland, Liverpool*

The essential steps of the operation are the removal of a substantial wedge of bone from the posterior third of the os calcis and its insertion into a niche on the dorsal surface of the neck of the astragalus, close to the articular surface for the tibia. If the wedge is inserted accurately, it forms a block to excessive dorsiflexion. The procedure and patients before and after the operation were clearly illustrated by a film.

#### *Ossous Dystrophy Following Icterus Gravis Neonatorum by Dr. Francis Braid, Birmingham*

Two cases were described in detail in which there was a disease characterized by (1) jaundice, of the familial icterus gravis type at birth, with achooza; (2) pathological pigmentation of the skin; and (3) a generalized cystic condition of the bones, which developed some time after birth. Dr. Braid discussed the possibilities of the origin of the bone disturbance, stating that possibly it represented an accompanying developmental defect, or it might be secondary to cirrhosis of the liver (present in both patients) which could very well have disorganized the storage and utilization of vitamins.

#### *Tuberculous Infection of the Bursa over the Greater Trochanter by Mr. T. S. Donovan, Birmingham*

Mr. Donovan gave a detailed account of five patients who had suffered from tuberculous infection of the subgluteal bursa. From his experience he made a plea for early excision, as treatment by immobilization of the hip in recumbency had proved ineffective.

#### *Snapping Jaw by Mr. A. Cameron Armstrong, Liverpool*

The pathology of this condition was discussed, and an operation for the removal of the torn meniscus was described and illustrated by a cinematograph. Through a short oblique incision in front of the ear the zygomatic arch is exposed and a half inch of it is removed (to be replaced at the end of the operation) immediately in front of the eminencia articularis. This procedure gives a clear view of the anterior and anterolateral aspects of the joint, and excision of the meniscus is easy. In the two patients on whom the operation was performed, a temporary paresis of the frontalis muscle developed, but recovery was complete in a few weeks.

#### *Roentgenographic Changes of Childhood as Seen in Adult Life by Dr. J. F. Brailsford, Birmingham*

Dr. Brailsford showed an interesting series of roentgenograms of various bone dystrophies in patients with whom he had been able to keep in touch from childhood to

adult life. He discussed the relationship between epiphysiolysis of the upper end of the femur and renal rickets, and described in detail the roentgenographic appearances in the "preslipping" stage. He regarded infantile coxa vara as a localized bone dystrophy. Bone changes of a similar nature were sometimes seen in cleidocranial dysostosis and in Albers-Schönberg's disease.

*Non-Traumatic Dislocation of the Toes* by Mr. Sayle Creer, Manchester

Mr. Creer reported the cases of thirty-six patients in whom non-traumatic dislocation of one or more toes at the metatarsophalangeal joint had taken place. The majority had occurred in association with hallux valgus and metatarsal-arch defects; pes cavus was present in only one patient. In three cases, there were plantar sinuses leading down to the dislocated joints.

Mr. Creer disagreed with Branch's theory that the dislocation is produced by interosseous muscle action, and he demonstrated very clearly in a film that these muscles on faradic stimulation have an action quite different from that ascribed to them by Branch. It was, therefore, concluded that the extensor tendons were the dislocating factors (in association, of course, with deformities already present). Treatment consists of tenotomies of the extensors in the early stages. When the dislocation has been long established, excision of the base of the phalanx is necessary.

**AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS**

The Seventh Annual Convention of the American Academy of Orthopaedic Surgeons will be held in Memphis, Tennessee, January 16 to 19, 1939, under the presidency of Dr. John C. Wilson of Los Angeles. The headquarters will be at the Peabody Hotel.

On Monday morning, January 16, a clinical program will be presented under the auspices of Dr. Willis C. Campbell, of Memphis. Monday evening has been set aside for a series of "reunion" dinners, so that the members who have been trained in the various hospital services may meet together. Any member wishing to arrange one of these dinners should notify Dr. Willis Campbell. Tuesday evening will be devoted to an informal dinner and entertainment, and on Wednesday evening the formal banquet will be held, when the scientific awards and presentation of medals will be made.

The following scientific program has been arranged:

**TUESDAY, JANUARY 17**

*Morning Session*

Posterior Fasciotomy in the Treatment of Back Pain.

Dr. Clarence H. Heyman, Cleveland, Ohio.

Primary Anterior Congenital Dislocation of the Hip.

Dr. C. H. Crego, Jr., St. Louis, Missouri.

Dr. H. R. McCarroll, St. Louis, Missouri. (By invitation.)

Principles Involved in the Treatment of Congenital Club-Foot.

Dr. J. H. Kite, Decatur, Georgia.

Water Balance in Orthopaedic Surgery.

Dr. Frederick A. Coller, Ann Arbor, Michigan. (Guest Speaker.)

Review of Poliomyelitis Epidemic in Toronto during 1937.

Dr. A. B. LeMesurier, Toronto, Canada. (By invitation.)

Operative Treatment of Upper-Extremity Paralysis.

Dr. Leo Mayer, New York, N. Y.

*Executive Session—12:00 Noon*

*Afternoon Session*

Bone Block for Paralytic Drop-Foot.

Dr. L. D. Smith, Milwaukee, Wisconsin.

Acromioclavicular Separation.

Dr. Leonard Barnard, Oakland, California.

Osteoclasis for Supination Contracture of the Forearm.

Dr. Walter P. Blount, Milwaukee, Wisconsin.

Subtrochanteric Osteotomy for Pathological Dislocation of the Femur.

Dr. Beveridge H. Moore, Chicago, Illinois.

Oblique Tibial Fracture.

Dr. Edgar D. Oppenheimer, New York, N. Y.

Surgical Treatment of Joint Tuberculosis.

Dr. Mather Cleveland, New York, N. Y.

Arterial Disease of the Extremities

Dr. C. Glenn Barber, Cleveland, Ohio.

Formation of the Intervertebral Disc with Referred Sciatic Pain.

Dr. Herman F. Johnson, Omaha, Nebraska.

### WEDNESDAY, JANUARY 18

#### Morning Session

Central Bone Graft in Joint Arthrodesis.

Dr. R. Nelson Hatt, Springfield, Massachusetts.

Pseudo Fracture of the Tibia.

Dr. Sumner M. Roberts, Boston, Massachusetts.

Astrogalectomies and Treatment of Calcaneoalgus.

Dr. T. Campbell Thompson, New York, N. Y.

President's Address.

Dr. John C. Wilson, Los Angeles, California.

Sulphanilamide.

Dr. Perrin H. Long, Baltimore, Maryland.

Suppurative Arthritis of the Hip.

Dr. Paul H. Harmon, Springfield, Illinois.

Dr. Carroll O. Adams, Chicago, Illinois.

Arthroplasty of the Hip.

Dr. M. N. Smith-Petersen, Boston, Massachusetts.

#### Afternoon Session

Chronic Inflammation of the Meninges and Cauda Equina Associated with Instability of the Lumbosacral Joint

Dr. Edwin M. Deery, New York, N. Y. (By invitation.)

Fractures of the Spine and Tetanus

Dr. Steele F. Stewart, Los Angeles, California.

Dr. Harry Dietrich, Los Angeles, California. (By invitation.)

Dr. Rolla Karshner, Los Angeles, California (By invitation.)

Estrogenic Stimulation as a Treatment for Marie-Strumpell's Disease.

Dr. Denis S. O'Connor, New Haven, Connecticut.

Joint Xanthomata: A Clinical and Pathological Consideration.

Dr. Philip D. Wilson, New York, N. Y.

Dr. Dominic DeSanto, New York, N. Y. (By invitation.)

### THURSDAY, JANUARY 19

#### Morning Session

Symposium: Non-Union of Fractures of the Neck of the Femur.

Dr. Melvin S. Henderson, Rochester, Minnesota, Chairman.

1. Pathology.

Dr. Dallas B. Phemister, Chicago, Illinois

2. Restoration of Bony Union.

Dr. Willis C. Campbell, Memphis, Tennessee

Dr. Alberto Inclán, Havana, Cuba.

Dr. M. N. Smith-Petersen, Boston, Massachusetts.

Dr. Paul B. Magnuson, Chicago, Illinois

3. Operations Devised to Prodeee Skeletal Support.
  - Dr. Armitage Whitman, New York, N. Y.
  - Dr. Paul C. Colonna, Oklahoma City, Oklahoma.
  - Dr. Fred H. Albee, New York, N. Y.
  - Dr. Herman C. Schumm, Milwaukee, Wisconsin.
  - Dr. A. Bruee Gill, Philadelphia, Pennsylvania.

*Afternoon Session*

## Symposium Continued:

4. Summary by Chairman.
5. Question-Box Hour.

*Executive Session***ACKNOWLEDGMENTS**

*The Journal* wishes to aeknowledge the reeeeipt of the following publications sent to the Editorial Department:

- Anales de la Clinica Quirurgica (Hospital "Arzobispo Loayza", Lima), I, No. 1, 1938.
- Boletín de la Sociedad de Cirugía de Montevideo, IX, No. 3, 1938.
- Boletines de la Sociedad de Cirugía de Rosario, V, Nos. 4, 5, and 6, 1938.
- Bollettino e Atti della Reale Accademia Medica di Roma, LXIV, Fasc. 1-4, 1938.
- The Child (Washington, D. C.), III, Nos. 2 and 4, 1938.
- Cleveland Clinic Quarterly, V, No. 4, 1938.
- Current Medicine (Los Angeles), V, No. 10, 1938.
- Gaceta Peruana de Cirugía y Medicina (Lima), I, Nos. 6 and 7, 1938.
- International Health Division, Annual Report for 1937. New York, The Rockefeller Foundation, 1938.
- The National Foundation for Infantile Paralysis Incorporated. General Statement of Plans and Appointment of Committees. New York, 1938.
- Radiography and Clinical Photography (Rochester, N. Y.), XIV, No. 5, 1938.
- Roche Review (Nutley, N. J.), II, No. 12, 1938; III, Nos. 1 and 2, 1938.
- The Rotarian (Chicago), LIII, No. 6, 1938.
- The Story of Irradiated Evaporated Milk. Chieago, Irradiated Evaporated Milk Institute, 1938.
- La Tribuna Média (Habana), XII, Nos. 248-249, 1938.
- University of Chieago. Announeements of the Medieal Schools for the Sessions of 1938-1939, XXXVIII, No. 15, 1938.
- Vida Nueva (Habana), XLII, Nos. 3 and 4, 1938.
- \*Diseases of the Nose, Throat and Ear. W. Wallae Morrison, M.D. Philadelphia and London, W. B. Saunders Co., 1938.
- \*The Treatment of Fraetures. Charles Loeke Seudder, A.B., Ph.B., M.D., F.A.C.S. Ed. 11. Philadelphia and London, W. B. Saunders Co., 1938.

\* Received too late for review in this issue. A review will appear in the April number.

# Current Literature

MODERN SURGICAL TECHNIC. Max Thorek, M.D., K.L.H. (Transl); K.C. (Italy). Philadelphia, J. B. Lippincott Co., 1938. \$33.00.

This book covers the broad field of general surgery in three volumes with 2,015 pages of text and 2,174 illustrations. The work, though comprehensive, is never confusing, due to excellent choice and handling of material. The saying "there is nothing new under the sun" is probably true. This book does not attempt to present new procedures in operative surgery to the exclusion of older ones of proved value. No small part of the advance in surgical technique in recent years is due to application of more simple methods in performing certain of the older standard procedures. The text clearly portrays by word and picture the more recent advances in general surgery. Commonly performed operations are described in sufficient detail.

Recent advance in surgery is due, in no small part, to the work performed in the clinical and experimental laboratory. An adequate knowledge of the basic sciences—physiology, biochemistry, and pathology—is essential for successful surgery. However, it is obvious that only a small part of surgery can be obtained in the lecture room. Skill is due largely to repetition and to experience, but even these alone, unguided, may not prove sufficient. If a surgeon is to perform an operation satisfactorily, he must know what to do and how to do it. In this book, the surgeon will find described one or more accepted procedures applicable to the problem in which he is interested. The description is step by step, so that to one unfamiliar with the procedure the technique will be plain. A review of surgical anatomy precedes each operative procedure.

Volume I opens with general operative considerations. The relationship of the surgeon to his art and to his patient is discussed. Preoperative and postoperative problems are considered in some detail, as are those pertaining to the operating suite and the operation in general. There follows an excellent chapter on the subject of anaesthesia.

The second part of this volume deals with surgery of the head and neck and with plastic surgery. Although these chapters may not contain all that is known about the various areas, except for the surgeon specializing in a given field, they include most that is important and practical. As is the case throughout the book, the text is abundantly and excellently illustrated.

Volume II covers surgery of the nerves, vessels, and bones. The peripheral nerves, sympathetic nerves, blood and lymph systems are taken up. Various approaches for sympathectomy are shown. The operation of chordotomy is discussed. There follows a chapter on problems of the peripheral circulatory system, in which an excellent and complete presentation of this increasingly important field of surgery is given. A chapter on orthopaedic surgery more than fulfills the needs of the general surgeon. Amputations and articulations and fractures and dislocations complete this phase of the book.

The last half of Volume II has to do with surgery of the breast and chest. Although chest surgery is fast becoming a field set aside for the chest specialist, the general surgeon from time to time finds himself confronted with a problem in chest surgery. If his mind is not entirely clear upon the proper conduct of a case in which there is a penetrating wound of the chest, for example, this chapter upon chest surgery will prove invaluable.

Volume III presents surgery of the abdomen. The chapter on stomach surgery is one of the best. In fact, the general surgeon will find the third volume of the greatest help, covering as it does the surgery of the intestines, the liver and the biliary passages, the pancreas, and the spleen. The illustrations in this volume are especially good. The volume concludes with chapters on gynaecological and genito-urinary problems.

In the plethora of recent books on surgery, the few that are really good stand out the more. This book on *Modern Surgical Technic* is one which gains by comparison. It is written by a master of general surgery. The results of over thirty years' experience and

study are recorded between its covers. The common surgical procedures which confront us all, the master or the pupil, are simply and plainly told. It is to the general surgeon, great or small, that this book will prove of inestimable value.

**LES TUMEURS MALIGNES PRIMITIVES DES OS. CLASSIFICATION, ÉTUDE CLINIQUE ET RADIOGRAPHIQUE.** Georges-Claude Leclerc. Paris, G. Doin & Cie, 1938. 60 francs.

This book represents an analysis of cases of primary malignant tumors of bone which have been collected by Prof. Tavernier, who has written the preface.

The author has recognized the difficulty of making an accurate differential diagnosis of bone tumors. Since the period when they were regarded as exostoses, each observer has added his contribution, which has helped to clarify the situation, but, even with the new facilities for study and observation (including the x-ray), there still exists great difficulty in satisfactorily classifying these tumors. Although it may be possible to recognize the presence and location of these tumors, it is frequently impossible to determine whether or not they are actually malignant.

An excellent discussion of the factors which make difficult an accurate classification is given, followed by the various classifications which have been proposed at different times by investigators of this subject, beginning with the fundamental one of Nové-Josserand and Tavernier and including those of the Registry of Bone Sarcoma of the American College of Surgeons, Kolodny, Geschickter and Copeland, and Hellner. The author then presents his own classification, based on the observation of his cases and taking into account the histological, anatomical, roentgenographic, and clinical aspects. It is not based on any one of these elements alone, however, for many tumors which are identical histologically are very different from the point of view of evolution and macroscopic anatomy. The classification is largely clinical and is as follows: osteogenic sarcomata (primary, secondary, and generalized); fibrosarcomata; sarcomata of bone marrow; primary epithelioma; and cancer of bone fistulae.

After a thorough consideration of each of these types, the author discusses the importance of roentgenography and biopsy in making a diagnosis, and emphasizes the fact that in difficult cases it is necessary to compare the clinical, roentgenographic, and histological findings. He stresses the need of early diagnosis and states that central registries for these bone tumors, which have been established in some countries, have given opportunity for more accurate prognosis.

Dr. Leclerc believes that one must remain somewhat skeptical as to the efficiency of therapeutic methods, for probably the cured cases are the most favorable types and the same methods of treatment do not appreciably aid the more severe forms.

The forty-five roentgenograms which illustrate the different types of bone tumors, with brief case histories, are grouped in the last section of the book and might be considered as an independent atlas. A very comprehensive bibliography of the French and foreign literature on this subject since 1932 concludes the book.

This very simple and at the same time complete consideration of the subject of primary malignant tumors of bone will be of value to all surgeons and roentgenologists who are concerned with the diagnosis and treatment of these tumors.

#### SURFACE AND RADIOLOGICAL ANATOMY FOR STUDENTS AND GENERAL PRACTITIONERS.

Arthur B. Appleton, M.A., M.D. (Cantab.), William J. Hamilton, M.D., B.Ch. (Belf.), D.Sc. (Glas.), F.R.S.E., and Ivan C. C. Tchaperoff, M.A., M.D., B.Ch. (Cantab.), D.M.R.E. Baltimore, William Wood & Co., 1938. \$5.50.

"Anatomy of the living subject" would have been a more comprehensive and perhaps more appropriate title for this amazingly valuable book, which transcends the usual limits of works on surface anatomy and includes all the anatomical observations which can be made, not only by inspection, palpation, percussion, auscultation, and digital

exploration, but also by the aid of the laryngoscope, the bronchoscope, the oesophagoscope, the ophthalmoscope, the proctoscope, the sigmoidoscope, the cystoscope, and aural, nasal, and vaginal specula, the x-ray, and the fluoroscope.

The anatomical information thus available is summarized in a series of chapters dealing with the upper limb, the chest and back, the abdomen, the head and neck, the vertebral column, and the lower limb, and is illustrated by a series of 338 admirable figures, some in colors, and including many roentgenographic negatives. Appendices contain convenient tables of ossification and of the segmental innervation of muscles.

Although designed primarily for students and general practitioners, this work should also prove of inestimable value to teachers of anatomy, of kinesiology, and of many clinical subjects. It is one of the latest and best of the texts which in recent years have done so much to carry anatomy from the domain of the dissecting room and of the microscope into the broader practical fields of its application in the medical and surgical sciences. As a product of teachers in the University of London, it reflects abundant credit not only upon its authors but also upon the scientific scholarship which their University fosters.

#### RÖNTGENDIAGNOSTIK DER GELENKE MITTELS DOPPELKONTRASTMETHODE (Roentgenographic Diagnosis of Joint Lesions by Means of the Double Contrast Method).

Dr. J. Oherholzer. (Fortschritte auf dem Gebiete der Röntgenstrahlen, Ergänzungsband 56.) Leipzig, Georg Thieme, 1938. 25 marks.

Both gas and a small quantity of radio-opaque material were injected into more than 2,000 joints over a period of eight years to furnish the x-ray material for this 120-page monograph. According to the writer, many of the studies made with the joints so prepared furnished an accurate diagnosis, which would have been possible otherwise only with exploratory arthroscopy. The history of joint injection and the gradual development of the method of inserting perabrodil and oxygen are outlined. The anatomy of knee, elbow, shoulder, and hip joints is reviewed with especial reference to the details affecting the distension of these joints with gas. The exact technique for injecting each one is described and illustrated by diagrams. It is agreed that the elaborate manometers, double needles, and two-way cocks may well be simplified for small clinics and that atmospheric air furnishes a satisfactory gas. The joints showed no demonstrable injury when they were investigated at operation following the injection of from two to three cubic centimeters of perabrodil. Under strict asepsis the danger of infection was minimal. No complicating gas embolism was encountered, and none was discovered in the histories of similar injections in the literature.

Excellent reproductions of roentgenograms illustrate the appearance of the normal knee with this technique. Anatomical variations and the artefacts due to improper injection are pointed out. Examples of injury to the fat pads, the cartilage, and the cruciate and lateral ligaments are presented. The details in the films certainly stand out with poster-like clearness, but many times there is little actual advantage over ordinary roentgenograms. One might question the advisability of treating tuberculous joints in this manner. There is certainly need for considerable experience before any of the films could be interpreted with great accuracy. Brief studies of the shoulder, elbow, and hip are included for completeness.

The format and cuts are excellent. The monograph, however, is perhaps of greater scientific interest than of practical value to the American surgeon.

**SURGICAL PATHOLOGY.** William Boyd, M.D., LL.D., M.R.C.P. (Ed.), F.R.C.P. (Lond.). Ed. 4. Philadelphia and London, W. B. Saunders Co., 1938. \$10.00.

As the name implies, this is an excellent treatise on pathology for the surgeon. In most of the diseases discussed a summary of the clinical features is given, so that the pathological condition may be correlated. Emphasis is placed on the gross pathology which concerns the surgeon at the operating table, although the microscopic details are adequate.

Among the new subjects added to the previous edition are lymphogranuloma inguinale, primary thrombosis of the axillary vein, the grading of malignant tumors, pilonidal cyst, parathyroid tumors, regional ileitis, granulosa-cell tumors, Brenner tumors and arrhenoblastomata of the ovary, the pathology of the intervertebral discs, and tumors of the islets of Langerhans.

Other sections have been augmented and revised. New material appears in connection with the experimental production of cancer, the etiology of tumors, heparin and thrombosis, mesenteric thrombosis, liposarcoma, implantation dermoids, acute intestinal obstruction, etiology of appendicitis, carbuncle of the kidney, the pathogenesis of renal calculi, Ewing's tumor of bone, and the relation of chronic mastitis to carcinoma of the breast.

The chapter on the gall bladder and liver may be cited to show how adequately Boyd covers his subjects. The anatomy, gross and microscopic, with the blood and nerve supply is described, followed by a statement of the physiology of the gall bladder and the theory of the Graham test. Infection of the gall bladder is usually by the streptococcus or the bacillus coli, although the bacillus welchii, the staphylococcus, or the typhoid bacillus may be the infective agent. The route of infection may be from the blood stream or from the liver.

Next the morbid anatomy of acute or chronic cholecystitis is described with excellent illustrations. Cholesterosis with the formation of gall stones of various sizes and shapes calls for several pages of discussion. Considerations of carcinoma of the gall bladder and tumors of the liver, abscesses, hydatid cysts, and gummata of the liver, and obstruction of the common bile duct complete the chapter.

This book is even better than the previous editions and is to be recommended for use by the mature surgeon, as well as by the surgeon of less experience.

**CHIRURGIE DE LA MAIN. LIVRE DU PRATICIEN. PLAIES, INFECTIONS ET TRAUMATISMES FERMÉS.** Marc Iselin. Paris, Masson et Cie, 1938. 65 francs.

The present volume is the first of two volumes on the surgery of the hand by the surgeon to the American Hospital at Neuilly. It is dedicated especially to the medical practitioner and is concerned principally with those acute affections of the hands which are usually first seen by the general physician. The volume is subdivided under three main headings: (1) wounds; (2) infections; (3) closed injuries of the hand and fingers.

The main thesis of the consideration of wounds of the hand and fingers is the danger of indiscriminate primary suture. Iselin places particular emphasis on the time element. If seen early—within less than six hours—careful débridement may be followed in selected cases by suture of the wound. If seen later, primary suture must under no consideration be performed, even after meticulous débridement. Where the wound involves the tendons, repair of the tendons is most safely undertaken at a secondary operation after the primary wound has healed and the danger of infection is overcome. The author believes that all wounds of the hand should be considered of major magnitude and treated with the surgical care and study customarily accorded to more serious injuries. He calls particular attention to the value of skin grafts in covering the denuded ends of the fingers. An interesting chapter is devoted to the disabling sequelae occasioned by injury to the sympathetic nervous system. These include the causalgias of Wier Mitchell, the post-traumatic oedemata, contractures, osteoporoses, and vasomotor disturbances. These are largely of sympathetic origin and are to be treated by the methods studied by Leriche.

The second part of the book is devoted to a treatment of wounds of the hand and fingers. The discussion is logically directed to each anatomical structure and division of the hand. It is particularly interesting because the author, while recognizing the merit of Kanard's classic work, disagrees with him in a number of important details. In the first place, he calls attention to a special localization of infection in the cellular space over the middle phalanx. This condition presents a characteristic clinical picture, which

is to be differentiated from tendon-sheath infection, infection of the anterior elbow space, or the infections which occur in the cellular spaces of the proximal phalanx. In the second place, the author shows that, on the basis of his anatomical and clinical studies, the mid-palmar space is larger than the classic description indicates and is to be subdivided into a superficial portion and a deep portion. Clinically, infection occurs more commonly in the superficial part of the mid-palmar space and may be readily differentiated from infection of the deep mid-palmar space.

In the treatment of infections of the tendon sheaths, Iselin observes that the most common localization of pus is at the upper eul-de-sac. Consequently, if operation is done sufficiently early, incision in this area, with thorough drainage to the dorsum, obviates the necessity for extensive exposure of the tendon.

In the matter of treatment, the author insists upon the need for early and adequate drainage, based upon accurate knowledge of the spread of the purulent material. Though it may give the patient comfort, the value of the hot bath is categorically denied, and its use is deplored, because of the danger of spreading infection. In its stead, adequate drainage and proper immobilization are urged as proper therapy. Where the loss of the flexor tendon is inevitable, amputation is to be considered.

The third portion of the book is given up mainly to the consideration of fractures. In general, the methods of Böhler are followed. A short table, showing the estimation of disability, is appended.

All in all, the volume is a most satisfactory addition to the library of the specialist as well as of the general practitioner. Without being too didactic, the principles of treatment are forcefully and tersely stated in language readily understood even by those only slightly conversant with the French tongue. The text is amply documented by well-chosen brief case reports and by numerous excellent photographs, roentgenograms, and diagrammatic sketches.

**ORTHOPEDIC APPLIANCES. THE PRINCIPLES AND PRACTICE OF BRACE CONSTRUCTION FOR THE USE OF ORTHOPEDIC SURGEONS AND BRACEMAKERS.** Henry H. Jordan, M.D. New York, Oxford University Press, 1938.

Surgical appliances form an important part of the treatment of orthopaedic and traumatic conditions, and their accurate application requires a sufficient amount of experience and skill to warrant the designation of this department of surgery as "mechanical therapy". Dr. Jordan stresses the importance of this part of the treatment of so many orthopaedic conditions and of a thorough knowledge of the principles of the fitting of braces. His presentation of the subject is of itself an argument against the too general use of stock apparatus and the relegation of the fitting of the appliances to the mechanic, which has unfortunately become too prevalent. He emphasizes the need of close cooperation between the surgeon and the bracemaker: the choice of the apparatus and the supervision of its fitting and application are the responsibility of the surgeon; the accurate and intelligent filling of the surgeon's prescription is the duty of the bracemaker.

In this book of 412 pages Dr. Jordan shares with the reader the results of his extensive and practical experience with many types of braces, splints, foot plates, etc. Emphasis is placed on those appliances the practical value of which has been proved through long use. He discusses the choice and the principles involved in illustrative cases and gives detailed directions for the taking of measurements and the making of models, which should be understood both by the surgeon and by the mechanic. He concludes his discussion with a chapter on the use of the roentgen ray in the construction of orthopaedic appliances.

The different types of apparatus are grouped anatomically, so that the reader may have immediate access to the appliances which are recommended for that part of the body which he is called upon to treat. The book is fully illustrated with 176 excellent cuts, 90 per cent. of which are original photographs and drawings. A comprehensive bibliography enables the reader who desires further information to obtain it from the original articles by the various authors whose apparatus Dr. Jordan describes.

This very practical and well-arranged manual on the principles and practice of brace construction should make possible a more efficient and harmonious cooperation between the surgeon and the bracemaker.

**PLASTIC SURGERY.** Arthur Joseph Barsky, M.D., D.D.S. Philadelphia and London, W. B. Saunders Co., 1938. \$5.75.

This is one of the best books on plastic surgery that the reviewer has seen. The author has not included all the methods of repairing a defect that have been described previously, but he has selected those which he has used and found to be satisfactory. The procedures described are the ones generally in use by all up-to-date plastic surgeons.

Many of the methods are illustrated by line drawings. For the most part, these are excellent and easily understood. In a few instances, particularly in the chapter on "Lips, Cheeks and Jaws", neither the legend beneath each drawing nor the text gives sufficient details to explain how the operation is performed. In the chapter on "Harelip and Cleft Palate" the drawings and the explanations are extremely detailed and clear. The photographs, not great in number, are well selected and convey proof of the efficacy of the method described.

Sufficient emphasis has not been placed on the treatment of keloids. No mention is made of Davis's method of partial excision. The dangers and complications of surgical excisions are not sufficiently emphasized.

The scope of plastic surgery is almost beyond comprehension. One would hesitate very much to consider that the treatment of bunions could be classified as plastic surgery, but nearly a page is devoted to this subject. One entire chapter deals with "Orthopaedic Aspects of Plastic Surgery". Roughly, one-half of the work that an orthopaedic surgeon does would come under this heading. Tendon shortening or lengthening, tendon transplants, arthroplasties of the fingers, elbows, hips, transfer and reconstruction of tendons and muscles for paralysis are all considered part of plastic surgery in this book. Many of the points brought out, however, should be of interest to the orthopaedic surgeon, even though he does not wish to consider himself a plastic surgeon.

**YEAR BOOK OF PHYSICAL THERAPY—1938.** Edited by Richard Kovács, M.D. Chicago, The Year Book Publishers, Inc., 1938. \$2.50.

This is a collection of abstracted articles from various professional journals, bulletins of clinical and laboratory research, and conference reports, which have appeared during 1937-1938. More than half are from foreign publications.

Part I is devoted to physical-therapy methods. Electrotherapy, artificial-fever therapy, and light therapy are described in detail and occupy 129 pages. The remaining seventy-two pages cover the following topics: hydrotherapy, which is well represented; massage, which is accorded only one article; manipulative surgery, which would seem to belong in a book on surgery; and exercise, which includes an article on the treatment of scoliosis that would probably be called strongly debatable by all orthopaedic surgeons.

Part II takes up applied physical therapy. The general considerations include physiological and psychological effects and the relief of pain by physical means. The remainder of the book is devoted to articles on the treatment of conditions amenable to physical therapeutic modalities. The range is great and embraces every medical department, including several subjects the incorporation of which in a book of this kind may be questioned. In the treatment of conditions in which massage, therapeutic exercises, and muscle training are described, only fundamental principles are expounded; detailed prescriptions are not given.

In this book, with its emphasis on the use of electrotherapy in all its branches, may be found the answer "to the apparent need to establish an accepted designation" for workers in physiotherapy. Obviously, the use of surgical diathermy and the electrical cautery knife belong to the surgeon. Artificial-fever therapy requires a special skill and,

with electrotherapeutic treatment, belongs in the hands of a medical man who has specialized in these fields and who may aptly be designated as "Doctor of Physical Medicine". The person who assists him may well be called a "physical-therapy technician". The title of "physiotherapist" should be reserved for those workers with adequate training, as prescribed by the Council on Education of the American Medical Association, who carry out treatment under the direct supervision of the orthopaedic surgeon, the general surgeon, or the neurologist. These men, knowing the general principles of the therapy which they order and the results which they wish to obtain, expect the physiotherapist to make out her own detailed prescription for each treatment.

It is regretted that, although the editor of this Year Book states that he does not subscribe to all of the views expressed in the articles abstracted, he does not designate them. In only a few instances does he express his personal opinion.

**INDUSTRIAL SURGERY: PRINCIPLES, PROBLEMS, AND PRACTICE.** Willis W. Lasher, M.D., F.A.C.S. New York, Paul B. Hoeber, Inc., 1938. \$6.00.

This book is written by a man who has had long and extensive experience in his field, and it contains much valuable information. This material, however, is to some extent obscured by a discussion of the general subject of traumatic surgery, which, although relevant, hardly seems necessary in a volume on industrial surgery. In his Preface, Dr. Lasher admits that he has not followed the usual orderly development of the typical textbook, but has confined his presentation to his own experience, and he warns the reader that the book "should be read in its entirety to obtain a conception of the subject as a whole". Certain problems are discussed with reference to special locations. The subject of malingering, for example, is considered in connection with disabilities of the shoulder, but the author states that the underlying principles are equally applicable to other articulations.

The author calls attention to the distinct differences between private practice and industrial work; in the latter, the surgeon is responsible not only to the patient, but also to the other parties whose interests are involved. The need of training and experience in successfully dealing with the problems which are met with in industrial surgery is emphasized. The first part of the book is devoted to a discussion of the organization, space, and equipment of the medical department. Then the various injuries are considered according to the anatomical grouping.

It is difficult to follow up successfully many of the industrial cases and to determine the actual end results. This is shown by the fact that of a series of 200 consecutive cases of back injury forty-five are still pending and in thirty-five the patients failed to return. The various estimates of disability in connection with cases treated in New York State are not applicable to the adjustment of compensation in other parts of the country, except as a basis for comparison.

The book concludes with an Appendix in which are described and illustrated various appliances mentioned in the text, which the author feels may be unfamiliar to those of less experience in the field of industrial surgery. For these surgeons, the results of Dr. Lasher's long and unique experience will be most helpful.

**RÖNTGENDIAGNOSTIK DER KNOCHEN- UND GELENKKRANKHEITEN** (Roentgenographic Diagnosis of Bone and Joint Diseases). Prof. Dr. Robert Kienböck. Heft 5. Rheumatoide Gelenkstüberkulose (Rheumatoid Joint Tuberculosis). Berlin und Wien, Urban & Schwarzenberg, 1938. 60 marks.

Failure to isolate the tubercle bacillus and negative cutaneous and animal-inoculation tests do not deter the writer from attributing a great variety of joint lesions to tuberculosis. In reviewing the material that he has collected over a period of forty years he has changed many of the diagnoses to "rheumatoid joint tuberculosis" on the basis of the roentgenographic appearance. The summaries of 378 cases include those of a variety of

diseases for the purpose of differential diagnosis. About half are "destructive joint tuberculosis" and are discussed under that heading. Bechterew's disease is classed as "exudative synostosing joint tuberculosis".

The reproductions of roentgenograms are for the most part good. The absence of laboratory reports decreases the value of the case summaries. The index—which is now supplied for the whole volume, including the preceding two publications—will facilitate the location of material which might otherwise be inaccessible under Prof. Kienböck's classification. The quotations from the literature are in themselves a valuable contribution. Too voluminous (600 pages) for connected reading, this number will prove interesting as a source of material for those who are studying either arthritis or tuberculosis.

**CHRONIC RHEUMATIC DISEASES: BEING THE FOURTH ANNUAL REPORT OF THE BRITISH COMMITTEE ON CHRONIC RHEUMATIC DISEASES APPOINTED BY THE ROYAL COLLEGE OF PHYSICIANS.** Edited by C. W. Buckley, M.D., F.R.C.P. New York, The Macmillan Co., 1938. \$3.25.

The fourth Report on Chronic Rheumatic Diseases, published by the British Committee, is quite instructive, as have been the first three volumes.

Prof. Davidson states that rheumatic diseases cost England annually about 20,000,000 pounds, and Scotland has 334,872 new cases each year. Dr. Hench says that the estimated number of cases in the United States is 3,000,000; 1,000,000 of these patients are disabled. Hospital facilities are inadequate for the need.

There are chapters on sciatica, radium and thorium X treatment, vaccine therapy, rheumatic fever, and physiotherapy, but the studies on rheumatic diseases in horses are most instructive. Wild horses do not have the disease, but domestic horses have spondylitis ankylopoietica rarely and osteo-arthritis frequently. The disease can be studied at any stage in a horse. Not only are the bones diseased, but the nerves themselves show degenerative hemorrhagic changes. Focal infection was not found in the horse.

The striking value of gold-salt therapy was graphically shown in a selected controlled series of cases of rheumatoid arthritis. With large doses, the disease became inactive in 50 per cent.; the swelling was reduced in 81 per cent.; and the sedimentation rate became normal in 83 per cent. With small doses, the disease became inactive in 38 per cent.; the swelling was reduced in 78 per cent.; and the sedimentation rate returned to normal in 43 per cent. With sterile oil, the disease became inactive in 5 per cent.; the swelling was reduced in 16 per cent.; and the sedimentation rate became normal in 26 per cent.

The book is well written and is worth careful study.

**DIAGNOSTIC ROENTGENOLOGY.** Ross Golden, M.D., Editor. New York, Thomas Nelson & Sons, 1938. \$4.50.

Thomas Nelson & Sons have issued renewal pages for the book on "Diagnostic Roentgenology", edited by Dr. Ross Golden. The admirable method which these publishers have used in their well-known loose-leaf series allows the reader to keep in touch with the recent advances and developments in the various departments of medicine.

The different chapters in "Diagnostic Roentgenology" are written by men who have been particularly well fitted by experience to report on the special phases of the subjects, and each has incorporated the new material which has appeared during the last two years. Three additional chapters are also included. There are excellent illustrations with very clear descriptions of the conditions which they portray. The longest chapter of the book is that on "Diagnosis of Diseases of Bones" and is presented by Dr. Paul C. Hodges, Dr. D. B. Phemister, and Dr. Alexander Brunschwig, and a whole new section is added to this chapter. The chapter on "Fractures" is written by Dr. Edward H. Skinner.

This excellent system is to be commended and should be welcomed by all those who use and are familiar with this work on diagnostic roentgenology.

**SPINAL ANESTHESIA.** Louis H. Maxson, M.D. Philadelphia, J. B. Lippincott Co., 1938. \$6.50.

Dr. Maxson has given a very complete and comprehensive study of spinal anaesthesia from every angle, thus filling a need which has long existed.

The Preface is by Dr. Wayne Babcock, to whom Dr. Maxson pays tribute as being one of the early pioneers of the country, and who, since 1904, has given spinal anaesthesia in over 40,000 cases. The author also credits Pitkin in 1927 with having given a new impetus to a nation-wide interest in spinal anaesthesia. He points out that Pitkin's needle reduced the damage to the nerve tissue and lessened complications such as headache and those of neurological pathology.

The author emphasizes the use of small doses of the agents in low concentration to make the technique safer for the patient. He also states with a degree of precision the pharmacological action of the drugs used in spinal anaesthesia, based on sound and rational physical principles and upon the known physiology of the structures involved, and gives his personal experience with the use of the drugs.

Dr. Maxson sums up the present status of spinal anaesthesia as follows: "Having passed the mountain peak of over-enthusiasm in 1929-1930, it seems now to have won its way to the high plateau of intelligent and rational utilization of its benefits to the patient and the surgeon." He believes that spinal anaesthesia offers to the surgeon, particularly to the surgeon specializing in abdominal surgery, a facility in operation given by no other type of anaesthesia, but he warns of the dangers of its use in the hands of the inexperienced and against its employment to the exclusion of other methods without recognizing the contra-indications.

This is an excellent book for those interested in the administration of intraspinal agents as well as for the medical student and the surgeon.

**BEDEUTUNG DES "VORHERIGEN ZUSTANDS" FÜR DIE BEGUTACHTUNG DER FOLGEN VON BETRIEBSUNFÄLLEN** (The Significance of the "Previous Condition" in the Estimation of the Sequelae of Industrial Accidents). Dr. P. Reckzeh. (Beihefte zur Monatsschrift für Unfallheilkunde und Versicherungsmedizin. Heft 23.) Berlin, Julius Springer, 1938. 3.60 marks.

Using the German insurance laws as the basis for his monograph, Dr. Reckzeh elaborates on the duties of the physician and the numerous considerations which he must bear in mind in evaluating disabilities. The symptoms of the patient do not constitute a satisfactory criterion, but the objective findings, even when they establish a pathological state, are likewise inadequate for this purpose when used alone. The ability of a man to do his work involves many factors that do not lend themselves to objective measurement. Many latent illnesses give no signs to indicate their presence. Psychic factors cannot be overlooked, particularly since the patient's concept of his illness can seriously affect his productivity. The interpretation of productivity is likewise subject to analysis and qualification. The German laws call for compensation for the time during which an employee is unable to engage in "his" work,—that is, the kind of work he has been doing and on the basis of which he was insured. The disabilities must be considered from the point of view of total or partial inability to accomplish his work, and the yearly income of the patient must be used as the basis for adjustment.

The previous condition of the patient must be borne in mind when the extent or the duration of the disability is evaluated. Under the heading of "previous condition", one must investigate such factors as age, sex, hereditary weaknesses, previous injuries, and pathological changes that exist at the time of the acceptance of the insurance responsibility. Physical deficiencies, mental annoyances, and psychiatric weaknesses all constitute the personal factor which, when added to the inherent dangers of an occupation, determines the incidence of accidents. All of these factors make it necessary that very complete histories of employees be taken and extremely careful examinations should be made, not only of the psychiatric background, but also of the acoustic and visual acuities. It

must be remembered that a previous deficiency, when enlarged by the addition of the disability of a new injury, usually brings about a decrease in the wage-earning capacity that is greater than the summation of the individual handicaps attributable to each. Even earlier ailments, not previously recognized, may justify higher compensation for an ordinary injury, because the knowledge that the newly recognized illness exists reduces the wage-earning capacity. The exact value of these factors is, however, difficult to determine.

It is the duty of the medical expert to decide if the accident is responsible for the development of a disability or if it merely serves to exaggerate the weakness of a previous illness. It is not important or necessary that the newly acquired illness occur during work, but one must be sure that the work is responsible for it. It is at times necessary to distinguish the severity of the trauma that is entirely attributable to the accident from that which occurs in a patient with a chronic defect. A patient with recurrent dislocation of a joint must receive a different rating in the event of a dislocation during work than the man who never had such an injury before. It is, therefore, obvious that these decisions are very difficult. Similar considerations obtain in the relation of death to disease. The death of a patient with a cardiovascular disease can be said to have been exaggerated by his work, but it is almost impossible to measure the rate of death acceleration attributable to the work.

The various affections of the systems and their bearing on compensable injuries are enumerated, and the author concludes with the remark that the better the medical expert is trained in clinical medicine, and the more he knows of the regulations of the insurance laws and interpretations, the more satisfactorily will he be able to do his duty to all concerned.

#### A SEX-DIFFERENCE IN THE INCIDENCE OF BONE TUMOURS IN MICE. F. C. Pybus and E. W. Miller. *The American Journal of Cancer*, XXXIV, 248, Oct. 1938.

In an inbred strain of mice with a high incidence of spontaneous bone tumors, it was found that these tumors are more than two and five-tenths times as frequent in the females as in the males (77.3 per cent. as compared with 29.6 per cent.) and occur nearly two and a half months earlier.—*Grantley W. Taylor, M.D., Boston, Massachusetts.*

#### CONTRIBUCIÓN AL TEMA: TRATAMIENTO DE LAS FRACTURAS VERTEBRALES (Contribución to the Subject: Treatment of Vertebral Fractures). Oscar R. Marottoli. *Anales de Cirugía*, IV, 28, 1938.

The author considers Putti a leading authority on the subject of fractures of the vertebrae and quotes him frequently. Putti believes that hyperextension really gives longitudinal traction. The author points out that this is in general quite true, but that it does not apply to fractures which are compressed to one side or in fractures of the facets. Putti exerts a longitudinal pull by a sling with a U-shaped support, which serves to give the hyperextension. This type of device is especially useful in cases where there is a side slip or in a fracture of the ramus.

It is very difficult to decide whether or not to operate on a patient in the presence of cord damage. The author quotes an interesting case of Dr. Bado and Dr. Tedemonte in which there was a fracture of the first lumbar vertebra with paraplegia. The fracture was reduced perfectly, but this did not relieve the patient's paraplegia. Careful study of the roentgenograms showed that there was a bone fragment pressing back into the spinal canal and causing the patient's symptoms. All types of cord injury are not the same, and a trauma may produce medullary concussion, medullary contusion, or compression or section of the medulla. Contusion and concussion are interestingly often a little distance away from the point of injury. Complete section of the spinal cord presents no problem whatever, for it is entirely hopeless. Compression of the spinal cord may be due to pressure on the cord from hemorrhage or a piece of bone. The symptoms from a

hemorrhage clear up promptly when the circulation becomes normal. This is in sharp contrast to the symptoms of compression due to pressure from a piece of bone, for these symptoms clear up only when the bone has been removed. This quite clearly points out the importance of the removal of a piece of bone which is pressing on the spinal cord. The diagnosis of a compression is made by the Queckenstedt test and the injection of lipiodol. The first step in the treatment of a fractured spine is the application of hyperextension; then, if the paralysis is still present, a laminectomy should be done. It is sometimes difficult to decide how long to wait before operating. Most cases of simple compression show some improvement within twenty-four hours after reduction of a fracture. All fractures of the spine should be reduced as early as possible. The fracture in medullary paralysis is not as important as hemorrhage and trauma around the cord. The author points out that there are many cases in the literature in which the patient probably recovers from medullary symptoms when a fracture of the vertebra is reduced. He closes his discussion with a quotation from Mathieu that in cases of fracture of the spine with no cord symptoms there is nothing to lose and everything to gain by immediate reduction of the fracture.—*Louis W. Breck, M.D., El Paso, Texas.*

#### SEUDO ARTROSIS DEL CUELLO DEL FÉMUR (Pseudarthrosis of the Neck of the Femur).

Lelio Zeno. *Anales de Cirugía*, IV, 38, 1938.

For seven years the author has been using the Smith-Petersen nail in treating cases of recent and old fractures of the neck of the femur. He believes that, regardless of the patient's age and physical condition, the sooner the nail is inserted the better. The primary consideration in elderly patients is the treatment of the fracture so that the shock may be minimized. Operation under local anaesthesia immediately after the injury reduces to a minimum the chance of death, and the operation is easy to do. He believes that in all fractures of the neck of the femur, recent or old, this osteosynthesis should be performed. There is only one exception to this rule,—namely, those old cases which show aseptic necrosis of the head of the femur. He dwells at some length on the matter of aseptic necrosis, and it is his opinion that, regardless of the method of treatment, aseptic necrosis will develop in those cases in which it is destined to occur.

In old ununited fractures of the neck of the femur, he sees no reason for employing the so-called palliative procedures, such as arthrodesis, osteotomy, resection of the head, arthroplasty, etc. He prefers a Smith-Petersen nail to a bone graft in these cases, for he believes that with this method a greater percentage of cures is obtained, there is less danger from the operation, and a long period in a cast is eliminated. It has been his experience that in old ununited fractures of the neck of the femur the interposition of fibrous tissue does not appear to prevent union, and it is not necessary to remove this at operation. The use of skeletal traction preoperatively in old cases, in order to obtain proper alignment of the fragments, is very important. The author presents the roentgenograms of three cases of old ununited fractures which occurred six, thirteen, and four months prior to treatment. In all cases satisfactory union took place.—*Louis W. Breck, M.D., El Paso, Texas.*

#### FUSION IN CHARCOT'S DISEASE OF THE KNEE. A NEW TECHNIC FOR ARTHRODESIS.

Ralph Soto-Hall. *Annals of Surgery*, CVIII, 124, 1938.

The author describes a two-stage operation for the fusion of the knee joint in Charcot's disease. The primary operation consists of multiple drillings of the femoral and tibial condyles with the object of improving the vascular supply. The leg is immobilized in a posterior plaster splint for a period of from four to six weeks, after which time the standard arthrodesis is performed.

The author explains that the pathology in these neuro-arthropathies is due to trauma and not to infection. There is no normal protective sensory mechanism, and, as a result of continued trauma, effusion, distention of the capsule, and relaxation of the ligaments occur. Marginal fractures and trauma to the articular cartilage produce loose

bodies and disorganize the joint. The bone becomes sclerotic and avascular, which is responsible for failure of fusion in these cases.

One case is reported in a man, fifty-one years of age. Three months following arthrodesis, clinical examination showed that the knee was solid. Three months later, roentgenographic examination showed bony union, and the patient was allowed free weight-bearing.

Microscopic studies of sections of bone removed at the second stage showed new capillary formation and new fibroblasts and osteoblasts in the channels where the drill had penetrated.

The author concludes that failure of arthrodesis in neuropathic knee joints is due to poor blood supply and sclerosis of the osseous tissue, and that increased vascularity and osteogenic power can be produced by preliminary drilling of the involved bones.—O. B. Bolibaugh, M.D., San Francisco, California.

**INTRAMEDULLARY PRESSURE WITH PARTICULAR REFERENCE TO MASSIVE DIAPHYSEAL BONE NECROSIS. EXPERIMENTAL OBSERVATIONS.** Ralph M. Larsen. *Annals of Surgery*, CVIII, 127, 1938.

The first part of the article is taken up with a review and an analysis of previous experimental studies related to the author's work. He then reports his own work, which consists of three groups of experiments on dogs.

In the first group, he studied the intramedullary pressure in the femur by means of a threaded steel cannula fixed in a cortical perforation and attached to a mercury manometer. In the second group of experiments, the author studied the effects of drugs on the intramedullary pressure. In the third group, a study was made of the degenerating changes occurring in long bones following elevation of the intramedullary pressure by physiological salt solution.

The author concludes that increased intramedullary pressure may be of extreme importance in the production of massive bone necrosis, and the experiments suggest that sequestration of dead bone occurs only when there has been complete destruction and long-continued exclusion of the vascular connections between bone and surrounding vascular tissue.

The author believes that these experiments have an extremely important bearing on the treatment of acute osteomyelitis. "Since massive sequestration of diaphyseal bone can occur only secondary to massive bone necrosis, and since massive diaphyseal bone necrosis results from ischemia produced primarily by pressure, the fundamental principle in the treatment of acute suppurative osteomyelitis is the release of pressure in the infected bone before the bone is killed."—O. B. Bolibaugh, M.D., San Francisco, California.

**THE DIFFERENTIAL DIAGNOSIS OF HYPERPARATHYROIDISM WITH SPECIAL REFERENCE TO POLYOSTOTIC FIBROUS DYSPLASIA (LICHENSTEIN-JAFFE).** John H. Garlock. *Annals of Surgery*, CVIII, 347, Sept. 1938.

The author reviews the various manifestations of hyperparathyroidism. Normally the parathyroid bodies control calcium and phosphorus metabolism. The blood serum calcium varies from 9.5 to 10.5 milligrams per 100 cubic centimeters, and the phosphorus varies from 3 to 3.5 milligrams per 100 cubic centimeters. Hyperactivity of the parathyroid function is produced by the presence of one or more adenomata.

Up to the present time the following criteria have been considered diagnostic of hyperparathyroidism:

1. The usual clinical symptoms (bone and joint pain, muscle weakness, localized bone swelling, pathological fracture, disturbance of gait, and, in advanced cases, deformity of bone).
2. Characteristic roentgenographic findings (the bones of the skull present a fine granular appearance; the vertebrae have a coarsely granular appearance; there is thin-

ning of the trabeculae and cortex in the long bones; sometimes cystic formation is observed in the shafts of the long bones and in the pelvic bones).

3. Laboratory findings (hyperealeaemin, hypophosphataemia, an increase in serum phosphatase, and a negative enelium balance).

The author reports two cases of proved hyperparathyroidism and a third case, which at first was thought to be the same condition but later proved to be polyostotic fibrous dysplasia (Lichtenstein-Jaffe).

The author concludes that one should not be too hasty about exploring the neck in these cases and suggests that, if doubt exists, further investigation is necessary to determine if the skeletal lesions are predominately unilateral, and that a bone biopsy should be performed in order to differentiate the characteristic histological pictures of the two conditions.—*O. B. Bolibaugh, M.D., San Francisco, California.*

**MADELUNG'S DEFORMITY.** Joseph I. Anton, George B. Reitz, and Milton B. Spiegel. *Annals of Surgery*, CVIII, 411, Sept. 1938.

This exhaustive review and critical analysis of the literature on this subject shows that there are many discrepancies in the cases reported as Madelung's deformity. The article contains a tabulation of analysis of relevant data of 171 cases of true Madelung's deformity reported in the literature between 1855 and the present time.

The authors report one case in minute detail. The pathology, predisposing factors, and various etiological theories are discussed. They suggest calling the deformity dyschondroplasia of the distal radial epiphysis. They are inclined to believe that it belongs in the group of conditions which includes Calvé-Legg-Perthes, Osgood-Schlatter, Köhler's, and Kienböck's diseases.

The treatment which they recommend consists in palliative measures until the cessation of the growth. Then the deformity should be corrected by osteotomy. If the ulna is markedly longer, its projecting end must be resected.

The authors present the following classification of the various types of the deformity, which they believe is advantageous in view of the present state of the literature on this subject:

A. Presenting Radial Deformity:

1. With anterior bowing of the radius:

- a. Radial dyschondroplasia (genuine Madelung's deformity);
- b. Secondary static deformity; traumatic, luetic, inflammatory, tuberculous, osteitis, rickets, etc.;

2. Without bowing:

- a. Radial dyschondroplasia;
- b. Secondary static deformity;

B. Presenting Ulnar Deformity:

- a. Ulnar dyschondroplasia;
- b. Secondary static deformity.

—*O. B. Bolibaugh, M.D., San Francisco, California.*

**SURGICAL EMERGENCIES ARISING AS A RESULT OF INJURIES AT THE ELBOW JOINT.** M. G. Kini and Dr. P. Kesavaswami. *The Antiseptic*, XXXV, 433, 1938.

The authors report a series of 289 injuries at the elbow joint, of which the majority (184) were simple supracondylar fractures. They find that in children indirect violence plays the chief part in the causation of supracondylar fractures, whereas in adults direct violence is the main cause. Complications occurred in 28.2 per cent. of the supracondylar fractures. Malunion, which was the commonest complication, was satisfactorily treated by partial diaphyseotomy and osteotomy. Nerve injuries were second in frequency; the radial nerve was most often involved; the ulna nerve, next; and the median nerve, least often. Ischaemic contracture occurred in 3.6 per cent. of the cases. The authors be-

lieve it can best be avoided by immediate operative intervention. In the treatment of uncomplicated supracondylar fractures and of comminuted fractures, they recommend skeletal traction and graduated active flexion.—*Robert M. Green, M.D., Boston, Massachusetts.*

**ACUTE OSTEOMYELITIS OF THE LONG BONES OF ADULTS.** Isadore Zadek. *Archives of Surgery*, XXXVII, 531, Oct. 1938.

Impressed by the fact that the clinical picture of osteomyelitis of the long bones in adults is different from that found in children, Zadek reports nine cases of adult hematogenous osteomyelitis.

In these cases it is noted that the disease lacks the acute onset, the history of trauma, high febrile reaction, extensive destruction, and tendency toward sequestration found in childhood. In the adult, the roentgenographic changes are suggestive of endothelioma. The difference in the signs and symptoms is explained on the basis of the difference in circulation in the bone before and after epiphyseal ossification has taken place. The realization of the existence of this clinical entity is of importance in the recognition of this disease.—*I. William Nachlas, M.D., Baltimore, Maryland.*

**SUBACROMIAL BURSITIS. A CLINICAL, ROENTGENOGRAPHIC AND STATISTICAL STUDY.**

Samuel R. Rubert. *Archives of Surgery*, XXXVII, 619, Oct. 1938.

In a comprehensive article, Rubert presents the subject of subacromial bursitis from history to prognosis. A concise description of the anatomical picture and a consideration of the etiological factors are followed by a somewhat more elaborate description of the pathological picture. The roentgenographic observations are enumerated, and it is stressed that disease may be present without positive roentgenographic changes.

The author reports on a series of 288 cases seen in the orthopaedic department of the State University of Iowa. An analysis of these cases showed that the greatest incidence is between the ages of forty and seventy years, that sex does not play an important rôle, that the right arm is more frequently affected than the left, and that there is an associated arthritic involvement in at least 16 per cent. of the patients. Etiologically the cases were classified as traumatic, arthritic, and infectious.

The question of differential diagnosis is taken up fairly fully. The usual forms of treatment are enumerated, and it is reported that conservative measures gave satisfactory results in 69 per cent. of the cases; improvement in 19 per cent.; and failure in 12 per cent. Operative treatment in twenty-one cases resulted in cure in about one-half of the cases. The author recommends that operative intervention should be reserved only for those patients in whom there has been a complete rupture of the tendon or in whom the condition does not respond to conservative measures.—*I. William Nachlas, M.D., Baltimore, Maryland.*

**MAGGOT THERAPY FOR HEMATOGENOUS OSTEOMYELITIS OF THE TIBIA.** Stephen Maddock and Dorothy Jensen. *Archives of Surgery*, XXXVII, 811, Nov. 1938.

"It is natural to wonder whether maggot therapy for osteomyelitis is a medical fad or a significant contribution to science. After seven years of experience and many trials of various substitutes I still feel that the condition can be treated profitably with maggots and that no lesion should be given up as hopeless until maggot therapy has been tried."

Maddock bases his statement on his experience with the maggot treatment over a course of seven years. During this time he treated twenty-nine patients with hematogenous osteomyelitis of the tibia. All of them had been previously treated by the standard surgical procedures; usually the Orr technique had been employed. In all of these patients the maggot treatment was finally used. In these twenty-nine patients, representing thirty-one lesions, closure took place in twenty-six osteomyelitic areas. Two

patients were lost. Two patients had amputations that were brought about for other reasons; and one patient still requires treatment. It is Maddock's belief that the lesions are more permanently and satisfactorily cured through the maggot treatment than they are through the usual surgical procedures. It is also his belief that the period of hospitalization is considerably shortened, and that the earlier rehabilitation of the patient is enabled by this form of therapy.—*I. William Nachlas, M.D., Baltimore, Maryland.*

**SOPRA UN CASO DI PIEDE BIFORCUTO BILATERALE ED IL SUO TRATTAMENTO (A Case of Bilateral Bifurcation of the Foot and Its Treatment)** Rosario Marziani. *Archivio di Ortopedia*, LIII, 639, 1937.

The author reports the case of a five-year-old boy with a severe and symmetrical congenital deformity of all four extremities. In each hand there was absence of the thumb and of the two radial fingers and synostosis of the proximal phalanges of the ulnar fingers. Both feet appeared to be split and showed clinically only two toes,—one medial and one lateral, both being very long and broad. Roentgenographically, the medial ray consisted of three segments and was free clear into the metatarsal region; the lateral ray on the left showed two metatarsal bones, on the right only one. The patient was unable to wear shoes. A good functional result was obtained by plastic resection of the tarsometatarsal and metatarsophalangeal joints. As far as the pathogenesis of the deformity is concerned, Marziani considers an antenatal deformity, which may represent the result of a true mutation. External mechanical factors are certainly of no importance in the development of such a deformity.—*Ernst Freund, M.D., Los Angeles, California.*

**IL TRATTAMENTO PRECOCE DEL TORCICOLLO OSTETRICO COL COLLARE GESSIONATO A SPALLINA (The Early Treatment of Obstetrical Wry-Neck with a Plaster Collar with Shoulder Extension).** Rosario Marziani. *Archivio di Ortopedia*, LIII, 651, 1937.

The treatment consists in: (1) the application of two or three Schanz collars, each for from three to four days; (2) the application of a Schanz collar and a plaster-of-Paris bandage with a shoulder extension over the affected side; (3) gradual correction by putting the collar between the shoulder extension of the cast and the shoulder. This procedure takes about one month or one month and a half.

The second and third stages may have to be repeated until a definite result is obtained. The advantage of this form of treatment consists mainly in the gradual correction of the deformity without changing the bandage.—*Ernst Freund, M.D., Los Angeles, California.*

**TECNICA PERSONALE NEL TRATTAMENTO DELLE FRATTURE DELLA CLAVICOLA E SUOI RISULTATI (Personal Technique in the Treatment of Fractures of the Clavicle and Its Results).** Rosario Marziani. *Archivio di Ortopedia*, LIII, 659, 1937.

The author's method of treatment consists in (1) local anaesthesia; (2) manual reduction (elevation and hyperextension with abduction of the shoulder, direct pressure on the fragments); (3) temporary fixation of the reduced fragments by a strip of felt passed under the axilla and pulled upward and backward, and felt padding over the clavicle; (4) application of a plaster cast with one layer of sheet wadding, well modeled over the clavicle and under the axillary felt pad.

The results of this treatment in fourteen cases (six with infraction and angulation, eight with overlapping of fragments) have been excellent in every respect.—*Ernst Freund, M.D., Los Angeles, California.*

**LUSSAZIONE CONGENITA DELL' ANCA E GRUPPO SANGUIGNO (Congenital Dislocation of the Hip and the Blood Group).** Ettore Tranquilli-Leali. *Archivio di Ortopedia*, LIII, 681, 1937.

This article, divided in two parts, gives a very good review of the different theories on etiology and pathogenesis of congenital dislocation of the hip. The hereditary,

racial, and sex factors are discussed in great detail. Despite the fact that most modern authors consider an antenatal deformity as the predisposing cause of the condition and a mechanical factor as the final cause, one has to admit that the true nature of the deformity is still unknown. The author suspects a constitutional difference in the paternal blood groups, as this has been shown to be of importance in cases of sterility, of premature birth, and of abortion. He has investigated a series of cases and has found that of seventy patients with congenital dislocation of the hip fourteen were from parents with the same blood group; fifty-six showed a heteronymous combination. The relationship of fourteen to fifty-six corresponds to a percentage of 20 to 80 and is at considerable variance with the 36 per cent. in couples with matching blood groups and the 67 per cent. in blood groups which do not match. From this the author concludes that the relative percentage of harmonious blood groups decreases in the case of a congenital dislocation from 36 per cent. to 20 per cent., while the percentage of non-matching blood groups increases from 64.2 per cent. to 80 per cent. He further believes that the constitutional lack of harmony in the paternal germ cells may be considered as an allergic phenomenon, which acts upon the germ from the first stages of development.—*Ernst Freund, M.D., Los Angeles, California.*

**CONTRIBUTO ALL'EZIOLOGIA DELL'OSTEOCONDROMATOSI ARTICOLARE (OSTEOCONDROMATOSI SINOVIALE CONSECUTIVA A PROCESSO SETTICO).** [Contribution to the Etiology of Osteochondromatosis of the Joints (Synovial Osteochondromatosis Following an Infectious Process).] S. L. Carnevali. *Archivio di Ortopedia*, LIII, 713, 1937.

The author reports the case of a man, forty years old, whose left knee joint had been operated on for a blennorrhagic suppurative arthritis. There had remained pain and restriction of motion. The roentgenogram showed signs of hypertrophic arthritis, and these findings were confirmed at the time of operation. A form of arthroplasty was done, and there was postoperative drainage.

The author considers this to be a case of chondromatosis of the joints, a hyperplastic change of the synovial capsule which started with the gonorrhoeal infection. However, this seems to have been only a simple case of secondary hypertrophic arthritis and not one of true chondromatosis.—*Ernst Freund, M.D., Los Angeles, California.*

**OSTEOGENESI IMPERFETTA CONGENITA PRECOCE E TARDIVA (ANALOGIE E DIFFERENZE).** [Early and Late Osteogenesis Imperfata Congenita.] A. Mastromarino. *Archivio di Ortopedia*, LIII, 729, 1937.

In this lengthy article, Mastromarino demonstrates analogies and differences between the various types of congenital osteogenesis imperfecta; one form he designates as early, with manifestation *in utero* or in the immediate post-natal period; the other, as late, with manifestation after the second year of life. Both types, despite certain differences, seem to be manifestations of essentially the same disease, which sometimes shows itself very early, leading to severe forms with poor prognosis; sometimes skeletal changes occur later, and then the clinical picture is less severe and the prognosis is good. Seven cases observed by the author are reported in detail, and 200 cases, collected from the literature, are presented schematically. The different theories of etiology and pathogenesis are discussed. The therapeutic advantages of the use of diluted hydrochloric acid, proteins, and cod-liver oil are mentioned. This seems to be a very promising form of treatment in the late cases.—*Ernst Freund, M.D., Los Angeles, California.*

**SEMEIOLOGIA CLINICA DELLA CLAUDICAZIONE (Clinical Observations on the Limping Gait).** Antonio Poli. *Archivio di Ortopedia*, LIII, 805, 1937.

This report is richly illustrated, with pictures from older authors (Ducroquet) and moving-picture films. The author discusses the limp due to pain, the characteristics of

which are: shortness of the time of weight-bearing on the painful extremity; the rapid swing of the good leg, with occasional quick elevation of the arms; the forceful impression of the good foot on the ground; and the very light and short impression, with external rotation, of the painful foot. The painful extremity is kept in abduction and in external rotation. The knee is forward flexed when the weight is put on the good leg. During weight-bearing on the painful extremity, the body weight is shifted to the good leg. Walking is started with the painful leg. A long chapter is dedicated to the study of the limp due to the difference in length of the lower extremities, the gait with equinus or calcaneous deformity, knee deformities, congenital dislocation of the hip, and non-union of the neck of the femur. The last two chapters analyze the limp caused by changes in mobility and motility of the extremities. Limitation of motion or complete ankylosis of one of the larger joints of the lower extremities leads to very characteristic forms of limping, which are well described and illustrated. The more common types of paralysis, poliomyelitis, spastic paralysis, and progressive muscular dystrophy are analyzed, and the author has not omitted the various forms of gait which result from the use of artificial limbs.—*Ernst Freund, M.D., Los Angeles, California.*

**DEL PIEDE TORTO CONGENITO E DELLA SUA DISTRIBUZIONE REGIONALE IN RAPPORTO A QUELLA DELLA LUSSAZIONE C. DELL'ANCA E DEL TORCICOLLO CONGENITO** (Congenital Club-Foot with Its Regional Distribution in Comparison with Congenital Dislocation of the Hip and Wry-Neck). Antonio Poli. *Archivio di Ortopedia*, LIV, 45, 1938.

Poli has made an interesting statistical study with respect to the regional distribution of congenital deformities. He has used the rich material from the *Pio Istituto Rachitici* of Milan, which comprises 4821 cases of congenital club-foot, 8610 cases of congenital dislocation of the hip, and 458 cases of congenital wry-neck. From his study, as from a number of preceding Italian and foreign investigations, it appears that congenital deformities occur by far more frequently in rural districts. Foothills and low-hill regions furnish the greatest percentage of cases. Seaglietti in a similar study found the greatest number of deformities in the plains, but both authors agree that the mountainous regions show the smallest number of deformities. The fact that all three congenital deformities occur mainly in smaller communities, mostly situated not above 1000 feet, suggests a clue to the etiology and pathogenesis. A certain form of blood relationship has to be assumed because of frequent intermarriage of members of one family, as can be concluded from the same surnames of many patients coming from the same area.—*Ernst Freund, M.D., Los Angeles, California.*

**L'OSTEOTOMIA CUNIFORME DELL'ASTRAGALO NELLA CURA DELLE DEFORMITA DEL PIEDE** (Wedge-Shaped Osteotomy of the Astragalus in the Treatment of Foot Deformities). Carlo Schapira. *Archivio di Ortopedia*, LIV, 145, 1938.

Hueter's wedge osteotomy of the astragalus has recently been very warmly recommended by Galcazzi in resistant and old cases of congenital club-foot. Schapira has performed the operation on eleven patients from three to twelve years of age. Through a dorsal incision over the neck of the astragalus, a wedge, varying in size with the degree of deformity, is resected and the base is turned upward and outward. Correction of supination and the forefoot deformity can easily be obtained. The operation is usually combined with subcutaneous tenotomy of the plantar structures and plastic lengthening of the Achilles tendon. Photographs and roentgenograms of six cases of recurrent club-foot before and after the operation are presented. The same operation was also used with good results in paralytic foot deformities (spina bifida, poliomyelitis) and flat-foot.

—*Ernst Freund, M.D., Los Angeles, California.*

**THE PATHOLOGY AND TREATMENT OF RECURRENT DISLOCATION OF THE SHOULDER-JOINT** A. S. Blundell Bankart. *British Journal of Surgery*, XXVI, 23, 1938.

Ordinary dislocation of the shoulder is caused by a fall on the abducted arm. After reduction the rent in the capsule heals and the dislocation does not recur. The disloca-

tion which later becomes recurrent is caused by a fall either directly on the back of the shoulder or on the elbow, which is directed backward and possibly slightly outward. None of the operations described take into account the pathology in these cases. This type of dislocation is due to the detachment of the glenoid ligament from the anterior margin of the glenoid cavity.

The author describes the operation which he has used in twenty-seven consecutive cases without a recurrence.

The incision is made from the lower border of the clavicle over the coracoid and downward and outward along the anterior border of the deltoid. The deltoid and the pectoralis major are bluntly separated. The coracoid, with its attached muscles, is divided and reflected downward. The humerus is rotated, so as to expose the subscapularis muscle, and the muscle is divided near its tendinous insertion into the humerus. Inspection of the joint capsule may show a rent, with the glenoid ligament lying loose. If there is no rent, an incision into the capsule will show the glenoid ligament torn off and attached to the capsule. A thin shaving of bone is taken from the margin of the glenoid cavity. Holes are made through the underlying bone, and the capsule with the glenoid ligament is tied in place. The shaving of bone is replaced, and the other structures are restored to their original positions.—*Ernest M. Daland, M.D., Boston, Massachusetts.*

**ACUTE INFECTIVE OSTEOMYELITIS OF THE SPINE.** Philip Turner. *British Journal of Surgery*, XXVI, 71, 1938.

Reports of twelve cases of osteomyelitis of the spine are presented; in five instances the inflammation had reached the spinal canal.

The organism found is usually the staphylococcus aureus. The focus is usually small, and in the cervical region it is in the body, while in the thoracic and lumbar regions it is in the posterior arch or processes. As a rule, one vertebra is involved and the infection is superficial. Sequestra are rare and small when they do appear. An involucrum does not form.

Complications consist of infections of the spinal cord, urinary infections, and abscesses. Abscesses of the cervical spine appear in the neck or as retropharyngeal abscesses. In the thoracic region the infection spreads to the mediastinum or lung and is usually fatal. Lower down it may appear as a perinephric, subphrenic, or psoas abscess or even as an ischiorectal abscess.

Treatment consists of adequate drainage. The prognosis depends on the type and location of the infection, but is bad when the cord is involved.—*Ernest M. Daland, M.D., Boston, Massachusetts.*

**AN OPERATION FOR RECURRENT DISLOCATION (SUBLUXATION) OF THE STERNOCLAVICULAR JOINT.** A. S. Blundell Bankart. *British Journal of Surgery*, XXVI, 320, Oct. 1938.

An operation which has been used successfully in four cases is described.

A curved incision is made, exposing the sternoclavicular joint. The periosteum beneath the capsule on the sternum is reflected, and the same procedure is carried out on the clavicle. [The illustrations show that a layer of bone has been reflected with the periosteum, but the text does not describe this step.] Two holes are bored from in front backward through the clavicle and similarly through the sternum. A strip of fascia lata is threaded through the clavicle with its loop behind. The two free ends are carried through the joint, back of the sternum and through the holes in the sternum, and are then tied and sutured. The bone flap and periosteum are sutured in place; the capsule is resutured; and the wound is closed.—*Ernest M. Daland, M.D., Boston, Massachusetts.*

**CALCIFICATION OF THE BURSA OF THE CORACOCLAVICULAR LIGAMENT.** H. J. McCur-  
rich. *British Journal of Surgery*, XXVI, 329, Oct. 1938.

This is a report of a case in which a man of fifty-one had sustained an injury while playing tennis. A firm mass appeared in the region of the coracoid, and the roentgeno-

gram showed the mass to be calcified. A calcified mass, two inches in diameter, was shelled out at operation. The coracoid process lay directly beneath the tumor, but the operator was unable to tell whether the calcification was in a bursa or beneath it.—*Ernest M. Daland, M.D., Boston, Massachusetts.*

#### **RECURRENT DISLOCATION OF THE SHOULDER. A PLEA FOR A SIMPLE OPERATION.**

Ernest W. Hey Groves. *British Journal of Surgery*, XXVI, 375, Oct. 1938.

Hey Groves reports ten patients successfully operated on by what he calls the "fascial sling operation". Recovery has been rapid and complete.

A small incision is made over the anterior border of the deltoid muscle below the coracoid process. A finger is inserted between the deltoid and the pectoralis major, and it is then pushed through the quadrilateral space, keeping close to the capsule until it reaches the back of the joint. A pair of artery forceps is passed through the tunnel, and a second incision is made down to its tip. Second and third tunnels are made from these skin incisions, deep to the deltoid and upward to the acromion. A strip of fascia is then passed through the three tunnels in front, below, and behind the shoulder joint, with the two free ends projecting above the acromion. The free ends are sutured, and the skin wounds are closed. The arm is placed in a sling. Underarm movements are allowed in ten days and overarm movements at the end of a month.—*Ernest M. Daland, M.D., Boston, Massachusetts.*

#### **FRACTURES IN THE REGION OF THE ELBOW-JOINT. S. L. Higgs. *British Medical Journal*, II, 230, 1938.**

*Supracondylar Fractures:* In children, in whom this type of fracture is common, general anaesthesia is more satisfactory than local. Following reduction, the elbow is brought up into full but not forced flexion, with the forearm pronated to relax the muscles. This position is maintained by a posterior non-padded plaster slab, extending from the top of the upper arm to the palm of the hand, and fixation is maintained on the average of four weeks, followed by a collar-and-cuff sling. The importance of avoiding massage, vigorous stretching, or manipulation of the joint is emphasized.

*Fractures of the Condyle:* These fractures are most commonly seen in children, because of the weakness associated with the developing centers of ossification. In fractures of the lateral condyle without displacement, a collar-and-cuff sling is employed for a fortnight, after which active use is resumed. Fractures of the medial condyle with downward displacement are best treated by open operation: first, the ulnar nerve is dissected free; then the condyle and attached muscles are replaced and fixed by a few catgut stitches or a beef-bone peg; and, finally, the ulnar nerve is transposed to a muscle bed in front of the condyle to make sure it will escape traumatic neuritis later on. The same manoeuvres are followed in cases of fracture of the condyle with displacement into the joint. Fractures of the lateral condyle usually involve part of the articular portion of the humerus. In children, the large fragment may carry the whole of the capitellum and even part of the trochlear surface. In those fractures with displacement, the operation is often difficult, because of rotation of the fragment at a distance from the joint. A posterior plaster slab maintains the postoperative position of right-angle flexion, with the forearm supinated and the wrist slightly dorsiflexed.

*Fractures of the Head of the Radius:* It is important to keep in mind that in a case of a supposedly sprained elbow there may often be a fracture of the radial head. With a crack in the head of the radius and little or no displacement, treatment consists of fixation of the elbow in full flexion with supination of the forearm for one month. The results of conservative treatment in fractures of a segment with displacement are poor, because of persistent pain and stiffness and the later development of traumatic arthritis. The broken-off fragment should be removed by operation without delay. In comminuted fractures of the radial head, the entire head is removed, together with any loose fragments. Rotation movements of the forearm are encouraged from the start, and flexion extension of the elbow is permitted after a fortnight.

*Fractures of the Olecranon:* Pull of the triceps, with constant separation of the fragments, cannot be efficiently overcome by any method of splinting, not even by full extension with strapping and pads. Bony union will not be secure; nevertheless, a remarkably useful limb may result from fibrous union with separation of the fragments. Conservative therapy is suggested for elderly patients who are not required to do hard manual work. In all other instances, operative treatment is the method of choice. A curved incision, passing to the inner side of the point of the elbow, is employed. Aluminum-bronze wire, made of many strands and flexible for tying, or two strands of strong gut such as is used for fishing, will hold the fragments together. Silver wire is quite unsuitable. The wire should lie within the bone, only emerging at the sides of the lower fragment to grip the cortex and to meet at the triceps insertion where the knot is tied. A postoperative flexed position of the elbow is desired, but the amount of flexion depends on the security of the fragments, which can be tested before sewing up the wound.—*G. E. Haggart, M.D., Boston, Massachusetts.*

**FRACTURES OF THE SHAFTS OF THE FOREARM BONES.** E. W. Hey Groves. *British Medical Journal*, II, 296, 1938.

It is essential not only to obtain correct length and proper alignment of both bones, but also to restore outward bowing of the radius, in order that this bone may rotate around the ulna in the movement of supination and pronation. General anaesthesia is preferred for reduction, for local anaesthesia is not always easy to obtain because the bones lie deep in the soft parts and the solution will be diffused along the connective-tissue planes. In fracture of both bones, the reduction is maintained by anterior and posterior non-padded, molded, plaster splints.

In fracture of the mid-shaft, with gross displacement, continuous traction for the minimum of twenty-four hours is advocated. A padded band is placed around the upper arm, and the straps are separated by a spreader. On the distal forearm and hand, adhesive strips are bandaged to form a U,—the thumb and index finger are included in one arm of the U and the remaining three fingers in the other. The forearm and hand are maintained in a position of almost full supination, with slight dorsiflexion of the wrist. If there is a tendency for the bones to approximate, they are separated by digital pressure under fluoroscopic observation, and this position is maintained by longitudinal wooden rods along the long axis of the plaster, back and front; these rods are pressed in and fixed by circular turns of plaster, after the manner of Böhler. If secondary displacement results in a few days, the plaster is removed and skeletal traction is applied by means of Kirschner wires passed through the ulna just below the olecranon, and through the lower end of the radius and the ulna. When reduction has again been obtained, the plaster is reapplied, incorporating the wires.

In fracture of the shaft of the ulna only, reduction is obtained as described, and then a plaster cast is applied to the forearm in a position of mid-rotation. However, if the fracture is complicated by simultaneous dislocation of the head of the radius, the author definitely favors operation.—*G. E. Haggart, M.D., Boston, Massachusetts.*

**UNUSUAL INJURIES OF THE TARSUS.** George A. Fleet and F. Douglas Ackman. *The Canadian Medical Association Journal*, XXXIX, 219, 1938.

The authors describe two cases in which there was anterior dislocation of the talus; in one of these cases, the dislocation was compound.

In the first case, treatment consisted of reduction of the dislocation and, with the foot dorsiflexed and in moderate inversion, the application of a padded plaster-of-Paris boot extending to the knee. Two weeks later, this boot was removed and an unpadded plaster boot with a felt heel was substituted. The patient was discharged from the hospital, and limited weight-bearing with crutches was permitted. Four weeks after reduction, he was allowed to walk with a cane. After four more weeks, the plaster boot

was removed and limited weight-bearing with crutches was permitted. An elastoplast bandage was worn to control the swelling of the foot. Ten weeks after operation, this bandage was removed, and the heel of the boot was raised a half inch. At the end of twelve weeks, ankle and foot movements were almost normal, and the patient walked with only a slight limp.

In the second case, after extensive débridement and reduction of the dislocation, the wound was sutured and a well-padded plaster boot was applied. Since there was elevation of temperature during the first ten days, accompanied by considerable pain in the foot, an infection was suspected, and it was decided to treat it by the Ott method. Four weeks after the operation the first dressing was done, and a small sinus was noted below the lateral malleolus. A posterior molded splint was applied, with elevation of the leg on a Braun splint. Eight weeks after operation, a walking unpadded plaster boot was applied, and the patient was discharged on crutches. Fifteen weeks after operation, the cast was removed. Twenty-six weeks after operation the patient could walk well, and four weeks later he returned to his occupation as a truck driver. Ankle flexion was almost normal, walking was painless, and there was no swelling. Stiffness of the tarsal joints and ankylosis of the talocalcaneum joint were present.

The authors believe that the good results obtained were due mainly to the long period of immobilization.—D. E. Robertson, M.D., Toronto, Ontario, Canada.

#### IDENTICAL DUPUYTREN'S CONTRACTURE IN IDENTICAL TWINS Harold Couch *The Canadian Medical Association Journal*, XXXIX, 225, 1938.

Two cases of Dupuytren's contracture in brothers who are identical twins are described, and photographs of the involved hands are shown. The author suggests that Dupuytren's contracture is "neither a disease nor an accident, but is, rather, a variation in growth of palmar fascia, the potentiality for which is inherited". He believes that if a pathological condition is found in one identical twin, the other twin should be examined for the same condition.—D. E. Robertson, M.D., Toronto, Ontario, Canada.

#### LAS FRACTURAS DEL COODO EN LA INFANCIA (Fractures of the Elbow in Children). Pedro Sánchez Toledo. *Cirugía Ortopédica y Traumatología*, VI, 11, 1938.

During the course of two years, 297 cases of fracture of the elbow have been treated at the Municipal Hospital for Children. These cases may be classified as follows:

Type	No. of Cases
Supracondylar fracture	197
Epitrochlear fracture	32
Fracture of the neck of the radius	30
Fracture of the lateral condyle	20
Fracture of the olecranon	7
Fracture of Monteggia .	5
Supracondylar and epitrochlear fractures	2
Fractures of the olecranon and head of the radius	2
Epitrochlear and epicondylar fractures	1
Fractures of the olecranon and epitrochlea	1

The twenty cases of fracture of the lateral condyle represent those fractures without marked displacement in which healing was obtained by simple immobilization of the fragments in a right angle. There were other cases of displacement and rotation of the fragments in which surgical treatment was required. In these cases, sutures of kangaroo tendon were employed. There were only two cases in which complete union could not be obtained,—one patient was lost track of and in the other there developed a pseudarthrosis, attributable to the long delay and the technical difficulties in achieving a perfect alignment. In the cases which were not treated early, there developed pseudarthrosis.

with atrophy of the condyle and marked joint changes. The removal of the condyle and an osteotomy to correct the ulnar bowing would have served the purpose better.

Of the thirty-two epitrochlear fractures, there were eight in which severe displacement could not be corrected by conservative treatment. The fragments were fixed in seven cases with sutures of kangaroo, and in one case with a nail. In almost all of these cases, a slight secondary displacement occurred.

The five cases of Monteggia's fracture were treated as follows: In one case of compound fracture, the ulna was sutured and the head of the radius was reduced manually. In the remaining four cases, excellent reduction was obtained by means of Dr. Alberto Inclán's apparatus for reduction of fractures of the forearm.

About one-half of the 197 supracondylar fractures did not present any displacement; the remaining half were accompanied by serious displacement, and some form of reduction was required. For reducing these fractures, the Jones method is used as early as possible. The author carries it out in from one to three stages, depending upon the degree of the oedema and the circulatory changes. In delayed cases with oedema and phlyctenae, traction is applied for twenty-four hours prior to manipulation.

For maintaining Jones's hyperflexion, the author uses a well-molded posterior plaster splint.

In each case, the fracture has been reduced under anaesthesia of the brachial plexus and very careful roentgenographic control. The average period of immobilization is eighteen days.

In the four cases of supracondylar fracture in which surgical intervention was necessary, an almost complete ankylosis of the elbow developed.

In treating cases of malunion, the author uses the following procedure: Through a double incision, all loose fragments are removed. The bone is then refractured and the surfaces are sutured, followed by Zeno's suspension method by means of transfixion of the ulna.

The author calls attention to three types of fracture which cannot be included in the group of supracondylar fractures and for which he has not been able to find an adequate classification:

1. Supracondylar fracture in which the inner border of the fracture line passes below the epitrochlea.

2. Fracture of the elbow of a type which the author calls "supratrochleo-condylar" with displacement.

3. Articular fracture involving the mid-portion of the trochlea and of the condyle, with forward displacement of the shaft and metaphysis. The author proposes to call this type a "semitrochleo-eondylar" fracture.—Alberto Inclán, M.D., Habana, Cuba.

**ARTROISIS POSTERIOR Y ANTERIOR DEL TOBILLO, ASOCIADA A LA TRIPLE ARTRODESIS EN EL PIE PÉNDULO Y PIE CALCÁNEO PARALÍTICO** (Posterior and Anterior Arthroereisis of the Ankle, Associated with Triple Arthrodesis, in the Flail Foot and Paralytic Pes Calcaneus). Alberto Inclán. *Cirugía Ortopédica y Traumatología*, VI, 59, 1938.

After reviewing the various techniques of arthroereisis and pointing out their disadvantages, the author describes his method.

Under general or spinal anaesthesia, a tarsal arthrodesis—usually including the astragalo calcanean, the astragalonavicular, and the caleaneocuboid joints—is carried out. Then either an anterior or a posterior arthroereisis is performed, according to the type of deformity. When employing the posterior arthroereisis, the author uses a modification of Campbell's technique, in which blocking is obtained by the elevation of the posterior aspect of the articular surface of the astragalus in the form of an osteocartilaginous flap. This is maintained by the head of the astragalus, which has been fashioned in the shape of a cock's comb. The double raw surface of the head is placed against the freshened calcaneo-astragalar and cartilaginous bed, and its upper articular surface is reserved for the tendons.

When carrying out an anterior arthroereisis, the author uses a modification of Putti's technique, employing the head of the astragalus for grafting, but in the form of a wedge, for keeping elevated the osteoartilaginous flap of the anterior portion of the astragalus; thus the base of the wedge is covered with cartilage.

In both types of arthroereisis the head of the astragalus is used for the transplant. The head is removed at the time of the astragalonavicular arthrodesis and fashioned in the proper shape for transplantation to the joint surface of the ankle. Thus a permanent and firm block is obtained, due rather to the change in the joint surfaces than to an external bone barrier.

The author has used this technique in twenty-five cases, with very gratifying results.

**FRACTURAS DE LA EXTREMIDAD SUPERIOR E INFERIOR DEL HUMERO EN EL ADULTO**  
(Fractures of the Upper and Lower Ends of the Humerus in the Adult). Alberto Barba Inclán. *Cirugía Ortopédica y Traumatología*, VI, 84, 1938.

The author describes his method of treatment of fractures of the upper end of the humerus in the adult. He uses a screw-traction apparatus, which permits skeletal traction on the olecranon (through a pin or wire) and counter-extension by means of a removable aluminum hoop, on the operating table. After anaesthetization of the brachial plexus, the patient remains seated on the operating table, and traction and counter-extension are applied. Counter-extension is made with the arm in the optimum position at an angle of 90 degrees or less, according to the individual ease, but never less than 45 degrees. This apparatus permits the application of the cast and reduction in one stage, the extension being maintained by the pressure of the cast. The apparatus can be removed easily, and is replaced by a spica. The patient can move about without risking a secondary displacement at the fracture site, as sometimes occurs when one of the metallic airplane appliances is used. Seven cases are presented, in which this treatment was employed successfully.

In treating fractures of the lower end of the humerus in adults, the author uses the method of Lelio Zeno,—namely, reduction of the fragments, transfixion of the olecranon, application of a plaster cast with the arm flexed at a right angle, and upward traction by weights with the patient in bed. Jones's flexion method is employed in cases where there are no multiple fragments. The author reports three cases, in one of which a complete ankylosis of the elbow resulted.

**CLINICAL ASPECTS OF ULTRA-VIOLET THERAPY.** Ethel M. Luce-Clausen. *Journal of the American Medical Association*, CXI, 311, 1938.

In this article special attention is given to radiation therapy in connection with diseases other than those of rickets and tetany. Also the danger of the excessive use of sun baths or of general radiation treatment is pointed out. Historical data pertaining to the discovery that ultra-violet rays both prevent and cure rickets are given.

The mode of action of the ultra-violet light is fully explained. Vitamin D, synthesized in the skin, is absorbed into the blood stream. It increases the concentration of phosphate in the blood and promotes the deposition of lime salts in the bone.

Ultra-violet-light therapy is effective in tetany. It is, however, not a strong therapeutic agent in promoting the healing of fractures and is not satisfactory in treating pulmonary tuberculosis. In erysipelas, psoriasis, and leprosy this form of light has not been proved to be of positive benefit.

The author believes that the rays have a direct bactericidal action on organisms within the skin. They further produce a hyperaemia of the skin and synthesize substances in it. The fact is pointed out that too much exposure may be harmful, since malignant tumors have been produced in rats and mice by excessive ultra-violet treatment.—

H. M. Childress, M.D., Dallas, Texas.

**PHYSICAL THERAPY IN THE TREATMENT OF FRACTURES.** Frank D. Dickson. *Journal of the American Medical Association*, CXI, 1016, Sept. 10, 1938.

In this mechanical age, fractures have increased both in frequency and in severity. The effectiveness of treatment depends not only upon the procuring of bony union, but also upon the time of disability and the quality of the end result.

A fracture should be treated as a surgical emergency with early reduction and adequate fixation. It is mostly during the after-care that physical therapy is indicated.

There are four basic forms of physical therapy,—heat, massage, exercise, and muscle stimulation. The first two produce muscular and vascular relaxation; the latter two promote venous and lymphatic flow and prepare the muscles to resume their normal active rôle.

Heat should be applied at low intensity and over a considerable period. Massage should be a light even stroking, centripetal in direction. Active "setting" of the muscles, even if the injured part is completely encased in plaster, has proved to be an excellent exercise. Electrical stimulation is useful in increasing circulation in the muscle. It should be painless and should not cause muscle cramps.

The author also points out the value of occupational therapy in the treatment of fractures.—*Eugene P. Legg, M.D., Dallas, Texas.*

**FASCIAL ADHESIONS IN PAIN LOW IN THE BACK AND ARTHRITIS.** Charles Murray Gratz. *Journal of the American Medical Association*, CXI, 1813, Nov. 12, 1938.

Traumatic and inflammatory lesions may result in myosynovitis or adhesions within the fascial planes. There is a limitation of motion of the affected joints and muscles with perhaps a direct involvement of the nerves.

Photographic and roentgenographic studies were made following air injections of the fascial planes of the low back. It was shown that the sheath of the sciatic nerve may become insufflated with air, although the injections are made at sites relatively remote. In dissections of the sciatic nerves, adherent fascial coverings were frequently found. The anatomical picture resembled that of a tendon after an acute infection.

In treating low-back pain, the physician must determine whether to decrease or to increase the patient's activities. Bed rest for the patient with acute symptoms is usually advised. Regulated exercise is beneficial provided pain does not persist after the motion has been stopped. Penetrating heat in the form of local or general hyperpyrexia is a true advance in treatment. Manipulation may be of benefit, but must be employed with care. Air insufflation of the fascial planes may release adhesions. The oxygen in air may have a direct therapeutic effect on the synovial covering of the fascial fibers.

Satisfactory results have been obtained by the author in twenty-three of forty-three cases by the use of air injections. He has further procured information concerning 355 other cases treated by this method. Most of the injections in the latter cases, however, were done for diagnostic purposes.

The author believes that the dangers of infection and embolism are relatively great in this form of therapy despite his report of 398 cases subjected to air insufflation, in which there were no complications.—*Brandon Carrell, M.D., Dallas, Texas.*

**SPONDYLOLISTHESIS AS AN ETIOLOGIC FACTOR IN BACKACHE.** Henry W. Meyerding. *Journal of the American Medical Association*, CXI, 1971, Nov. 26, 1938.

In this paper 583 cases of spondylolisthesis are reviewed. Backache is the most common symptom, and a forward downward displacement of the lumbar spine is the most common deformity. The author believes that the recognition and the treatment of this condition will become an increasing factor in solving the problem of chronic backache. He points out that in 1920 only one case of spondylolisthesis was diagnosed, while in 1937 eighty-one such cases were seen.

Congenital deformities were the most important etiological factors. Backache was the chief complaint in 80 per cent. of the cases. Seventy per cent. of the patients were males. In 10 per cent. of the cases, however, no symptoms were present, and the discovery was incidental to examination for other conditions.

Inspection and palpation, either without proctoscopic examination, may reveal the diagnosis in many cases. Roentgenograms must be taken to make an accurate diagnosis and to exclude such factors as tuberculosis, fractures, arthritis, and tumors.

The author has divided the cases into four grades depending upon the degree of forward subluxation present. His method of grading is as follows: If the fifth lumbar vertebra has slipped forward less than one-fourth of the distance across the lumbosacral joint, the spondylolisthesis is graded 1; if the vertebra has slipped less than one-half, the grade is 2; if less than three-fourths, the grade is 3; and if more than three-fourths, the grade is 4. Of 442 patients, 45.2 per cent. had grade-1 deformities, whereas only 10.6 per cent. had deformities of either grade 3 or grade 4. Incidentally, 44 per cent. had a reverse spondylolisthesis. *Benton Carell, M.D., Dallas, Texas.*

#### THE RATIONAL TREATMENT OF ACUTE HEMATOGENOUS OSTEOMYELITIS. J. Albert Key. *Journal of the American Medical Association, CXI, 2163, Dec. 10, 1938.*

Paediatricians and general practitioners are not sufficiently "osteomyelitis conscious". Frequently acute osteomyelitis is not recognized until late in the disease.

The causative organism varies with the age group. In infants under two years of age, the offending organism is hemolytic streptococcus in about 50 per cent. of the cases. Staphylococci are found in almost all the remaining half. In children over two the staphylococcus aureus accounts for about 90 per cent. of the infections. The pyogenic cocci are quick to invade and to destroy tissue, particularly if the process has no drainage. A focus in a bone is silent until the inflammation has reached the periosteum. At that time it is in need of surgical drainage.

The acute condition usually begins when the disease becomes localized in the bone. When to institute drainage of this focus is dependent upon the condition of the patient, the course of the disease, and the surgical judgment of the surgeon. That most cases of chronic osteomyelitis do not have early surgical drainage when in the acute stage has been shown by the author's study of 200 such cases, of which only nine had bone drainage during the first week.

Severely ill patients with a spreading infection of bone, who are seen early and who are in good general condition, represent the type of acute osteomyelitis that requires immediate surgical treatment. Local anaesthesia may be used, and the bone is opened as quickly and as gently as possible. The operation is essentially a drainage procedure *not* a sequestrectomy. The limb is then immobilized in hot, wet packs or in plaster of Paris. Repeated small blood transfusions are indicated if secondary anaemia develops, but their value is equivocal in the acute infectious stage. In children under two, no leeway is allowed, as the bone is more porous, permitting extra-osseous abscesses to form, and there is an even chance that the infection is due to streptococci and thereby *particularly* susceptible to sulphanilamide. Also, infants become dehydrated and toxic rapidly and do not withstand surgery well.

Patients with mild bone infections and not acutely ill do not require early drainage.

The author prefers not to operate upon extremely toxic patients in poor general condition. The operation is deferred only until the patient's condition becomes *sufficiently* systemic. The waiting is a matter of hours rather than of days.

Bacteriophage, toxoids, and immune sera have not proved to be of value in the early stages. At the present time, staphylococcus antitoxin is being given to some of the patients, but its use is still in the experimental stage.—*H. M. Children, M.D., Dallas, Texas.*

LE TRAITEMENT DU PIED TALUS PARALYTIQUE GRAVE (Treatment of Severe Paralytic Calcaneus). Jacques Leveuf et Pierre Bertrand. *Journal de Chirurgie*, LII, 145, 1938.

The authors perform a triple arthrodesis similar to the operation of Hibbs, in which a rather large section of the head and neck of the astragalus and a rather large posterior wedge from the calcaneum are removed. The foot is then displaced backward, and the heel is brought upward against the astragalus. They state that the peronei are usually present and are transplanted into the os calcis. If the peronei are not active, any plantar flexor muscles which are present may be used to replace the gastrocnemius and the soleus. After the operation, the foot is immobilized for two months in a plaster-of-Paris cast. At the end of three months, the patient is permitted to walk in a shoe.

The results in the six cases in which this operation was performed were satisfactory.

—J. Albert Key, M.D., St. Louis, Missouri.

INDICATIONS ET TECHNIQUE DES BUTÉES RETRO-GLENOÏDIENNES DANS LES LUXATIONS POSTÉRIEURES DE L'ÉPAULE (Indications and Technique for Retroglenoid Abutments in Posterior Dislocations of the Shoulder). Fèvre et J. Mialaret. *Journal de Chirurgie*, LII, 156, 1938.

The authors comment on the rarity of posterior dislocation of the shoulder and state that as a rule no open operation is indicated. However, in certain cases it is found that the head of the humerus tends to slip backward after reduction of the dislocation. They believe that this is due to a congenital deficiency of the shoulder and that in such cases operative intervention is necessary. Through a V-shaped incision, which begins at the acromion and extends downward along the lower border of the spine of the scapula to its mesial end and then outward and downward so that a V-shaped flap is retracted outward, the infraspinatus region is exposed, after the deltoid has been detached from its insertion at the spine of the scapula. By retraction of the infraspinatus and the teres minor muscles the posterior border of the glenoid is approached. The dislocation is then reduced by abducting and extending the arm and pushing the head of the humerus forward. Two thin bone grafts from the tibia are inserted into the neck of the scapula and the posterior margin of the glenoid and are extended outward along the posterior surface of the capsule of the shoulder. The wound is then closed and a plaster-of-Paris cast is applied and left on for six weeks. At the end of this time, active motion is begun.

One case of posterior dislocation of the shoulder is reported, in which a satisfactory result was obtained by this method.—J. Albert Key, M.D., St. Louis, Missouri.

LES COMPLICATIONS OSSEUSES ET ARTICULAIRES DES PARATYPHOÏDES (Bone and Joint Complications of Paratyphoid Fever). J. Calvet. *Journal de Chirurgie*, LII, 289, 1938.

The author discusses the bone and joint complications of paratyphoid and states that they are similar to those of typhoid fever and vary greatly in their clinical manifestations. He reports two cases of his own and sixteen from the literature.

In the first of his two cases, the patient complained of pain in the left leg, which had been present for eleven years. There was a tender scar with some thickening of the soft tissues over the anterior surface of the tibia, which had followed an injury nineteen years previously, but the symptoms had followed an attack of paratyphoid fever. At operation, the periosteum was found to be thickened and the bone roughened, and after the cortex was removed a small amount of pus was found. This contained a gram-negative bacillus, which exhibited the characteristics of paratyphoid B. After the operation, the wound healed rapidly.

In the second case, there was a rather large cavity in the upper end of the tibia, which contained a sequestrum. This had followed a febrile attack fourteen years before admission and had been operated upon on two occasions, but had not healed. At the

operation, the walls of the cavity were excised and the sequestrum was removed. Two years after the operation the wound was healed, and the cavity was filled with new bone. Culture from the material revealed paratyphoid A.—*J. Albert Key, M.D., St. Louis, Missouri.*

**PLANNING A HOSPITAL.** Sir Henry Gauvain. *The Lancet*, II, 95, 1938.

Sir Henry Gauvain has given a very interesting and illuminating description of the 300-bed Treloar Hospital for Crippled Children at Alton. This hospital is the most up-to-date hospital for crippled children in England today. It has many features which similar institutions in America might do well to copy. Five ward blocks, facing a terrace with a southern exposure, form a very impressive sight. The Silver Jubilee Treatment Centre, in which the operating rooms and the X-Ray and Physiotherapy Departments are housed, is the very latest of its kind in England. Sir Henry Gauvain has undoubtedly given as much time and thought to the planning of crippled children's institutions as any other person in the world today.—*A. R. Shands, Jr., M.D., Wilmington, Delaware.*

**MONARTICULAR ARTHRITIS ASSOCIATED WITH A DYSENTERIC BOWEL INFECTION.** J.

Dudley Benjafield and G. S. Halley. *The Lancet*, II, 616, Sept. 10, 1938.

A single case of arthritis of the hip, associated with a symptomless intestinal infection, is reported. The organism recovered from the intestinal contents was of a dysenteric type, similar to the bacillus alcalescens. Apparently the arthritis had been treated unsuccessfully by immobilization for ten months, but the patient recovered rapidly when she was encouraged to walk about and the dysenteric infection was treated with intestinal antiseptics, colon irrigation, and a vaccine.—*A. R. Shands, Jr., M.D., Wilmington, Delaware.*

**SOME OBSERVATIONS ON THE ARCHES OF THE FOOT AND FLAT-FOOT.** John Bruce and Robert Walmsley. *The Lancet*, II, 656, Sept. 17, 1938.

The authors review the conventional clinical teaching of the arches of the foot, and criticize the clinical evidence for the presence of the anterior metatarsal arch. A series of sections and dissections of foetal feet of different ages have been made and examined. These all demonstrate the presence of a longitudinal arch and a transverse arch in the region of the bases of the metatarsals. There is no evidence, however, to suggest the presence of a transverse arch in the region of the metatarsal heads in either foetal or adult feet. They urge that the diagnosis "anterior flat-foot" be dispensed with.

In the discussion of treatment of anterior metatarsal pain it is stated that pads which are intended to lie under the intermediate metatarsal heads and restore an imaginary arch are wholly irrational. Regulation of the body weight is always an important consideration, and circular strapping of the bare foot may relax the overstretched transverse ligaments. The most important single step, however, is the restoration of functional activity to the lumbrical-interosseous system, and in this connection the preliminary correction of a fixed toe deformity is essential. In the discussion of treatment of longitudinal flat-foot a plea is made for the improvement in the muscle tone of the foot by an appropriate mixture of rest and exercise, together with some adjustment of the load by regulation of the body weight, and its partial deflection to the outer side of the foot by raising the inner part of the sole.

This is an excellent article and should be read by every orthopaedic surgeon treating disorders of the foot.—*A. R. Shands, Jr., M.D., Wilmington, Delaware.*

**OSTEOMALACIA OF THE SPINE FOLLOWING THE ABUSE OF LAXATIVES.** E. Meulengracht.

*The Lancet*, II, 774, Oct. 1, 1938.

A very remarkable case of osteomalacia of the spinal column in a man, which developed after the daily use of Carlsbad salts over a period of thirty-five years, is reported.

It is thought that these salts transformed a certain amount of the food calcium into insoluble calcium sulphate, which was then evacuated. The condition of this patient resembles the calcium deficiency of the skeletal system sometimes found in coeliac disease and sprue, in which a certain amount of calcium is precipitated in the form of calcium soap and therefore evades absorption.—*A. R. Shands, Jr., M.D., Wilmington, Delaware.*

**THE TREATMENT OF ANKLE FRACTURES.** Walter Gordon Campbell. *The Lancet*, II, 872, Oct. 15, 1938.

The author reports a series of eighteen cases of what is described as a first-degree ankle fracture, in which only one side of the ankle joint is involved. Treatment consisted in the injection of 2 per cent. procaine into the hematoma, following which the patient was allowed to walk without support. He believes that such fractures are invariably stable and require no form of splint in their treatment. The two main arguments advanced against this method are: (1) displacement may result, and (2) non-union may be expected. Good results were obtained in all cases, with clinical evidence of union and no displacement.—*A. R. Shands, Jr., M.D., Wilmington, Delaware.*

**FUNKTIONELLE BEHANDLUNG REPONIERTER WIRBELBRÜCHE** (Functional Treatment of Reduced Fractures of the Spine). B. Karitzky. *Monatsschrift für Unfallheilkunde und Versicherungsmedizin*, XLV, 538, Oct. 1938.

The method of Magnus (conservative functional method without reduction) often gives end results which are unsatisfactory because vertebral insufficiency, nerve-root pain, and disability of the patient cannot be prevented or eliminated. The method of Böhler is inadequate, because the prolonged retention in the plaster cast makes it impossible to control the condition of the spinal muscles and prevents institution of remedial gymnastics.

Treatment of thirty-six cases of vertebral fracture by the writer's method consisted of reduction of the fracture and early institution of function. In fractures of the cervical or upper thoracic vertebrae, reduction is achieved by traction and followed by extension. In fractures of the lumbar or lower thoracic spine the suspension position is employed for reduction. With simple compression fractures no anaesthetic is required, although fracture-dislocations are reduced under anaesthesia. Following reduction, a plaster shell is made for the back. This extends from the spine of the scapula to the greater trochanter. At the upper border of the shell and above the symphysis pubis, strips of plaster are placed to complete the shell anteriorly.

From eight to fourteen days after reduction, functional treatment is begun. The anterior portion of the cast is removed. The patient is placed on a bed in the prone position and, with the plaster shell removed, massage and active exercises are employed for one hour each day. The exercises include all motions of the spine except flexion. After fourteen days, the crawling movements of Klapp are carried out. In the middle of the sixth week after reduction the plaster shell is discarded, and the hyperextended position of the spine is maintained by pillows placed under the back. At the end of the sixth week, the patient is allowed to sit up in bed. After seven weeks, he is allowed to walk, at first in a walking frame and later with two canes. Lordosis of the spine must be maintained by the active efforts of the patient. As a rule, the patient is dismissed after from eight to nine weeks. Massage and active exercises are continued until the patient is free from symptoms.

The duration of the healing process is approximately the same as that required by the method of Magnus and is shorter than that required by the method of Böhler.

Statistics on end results are not given, although they are to be included in the analysis of a larger series of cases to be presented later.—*R. J. Diltrich, M.D., Fort Scott, Kansas.*

**DIR SELBSTÄNDIGEN QUERFORTSATZBRÜCHE** (Isolated Fractures of the Transverse Processes). Bodo-Heinz Wiebeck. *Monatsschrift für Unfallheilkunde und Versicherungsmedizin*, XLV, 545, Oct. 1938.

An analysis is made of ninety-five cases of isolated fracture of the transverse processes, sixteen cases of this type combined with fracture of the vertebral bodies, and five cases combined with fracture of the spinous processes. All these cases were seen during the year 1935 in the surgical division of the *Krankenhaus* at Bergmannsheil. From a statistical study of all cases of spinal injury, the writer believes that isolated fracture of the transverse processes constitutes approximately one-half of all such injuries. The cause of this form of fracture is indirect trauma (muscle action). A description is given of the clinical and roentgenographic manifestations from the standpoint of differential diagnosis, treatment, and end results. The article includes many tables and lengthy discussions of the various features of this type of injury.—R. J. Dittrich, M.D., Fort Scott, Kansas.

**EIN BEITRAG ZUR KENNTNIS DER TRAUMATISCHEN BANDSCHIIBENPROLAPSE** (A Contribution to the Study of Traumatic Prolapse of the Intervertebral Disc). Eduard Otto. *Monatsschrift für Unfallheilkunde und Versicherungsmedizin*, XLV, 573, Oct. 1938.

The anatomical picture of prolapse of the disc was known to von Juschka in 1858 and to Virchow in 1875. The writer reports a typical case of this form of injury. Surgical removal of the disc, located between the first and second lumbar vertebrae, resulted in relief from pressure symptoms. Included also is a review of the German literature on this subject.—R. J. Dittrich, M.D., Fort Scott, Kansas.

**VITAMIN C AND CHRONIC ARTHRITIS.** K. K. Sherwood. *Northwest Medicine*, XXXVII, 288, Sept. 1938.

The lack of vitamin C causes greater permeability of the capillaries and hence oedema of the interstitial tissues. This oedema is present throughout the body in sub-clinical scurvy, and in arthritic patients causes the synovial membranes to become pinched in the impaired joints, causing pain. It also slows down the fluid exchange in the tissues and hence lowers metabolism. The author has found that improvement in arthritic patients is always accompanied by a return to normal of vitamin C. The converse is not true, however. He finds it necessary to supplement a normal diet with 1-300 milligrams of synthetic vitamin C daily.—Charles Lyle Hawk, M.D., Los Angeles, California.

**THE TREATMENT OF CONGENITAL DISLOCATION OF THE HIP IN ADOLESCENTS BY THE METHOD OF SKELETAL TRACTION.** V. M. Goldinova. *Orthopaedia i Travmatologia*, I, 38, 1938.

Skeletal traction, followed by appropriate fixation and proper after-treatment, is considered the method of choice in adolescent congenital hip dislocations. In a group of twenty-five patients between seven and twelve years of age, of which eleven had bilateral dislocations, the author reports twenty-three successful reductions.—Emanuel Koplan, M.D., New York, N. Y.

**THE SCHANZ OPERATION IN OLD CONGENITAL AND PATHOLOGICAL DISLOCATIONS OF THE HIP.** F. E. Eliashberg. *Orthopaedia i Travmatologia*, I, 55, 1938.

The author discusses the indications for this operation and sets up definite rules. The age period is limited to between fifteen and thirty-five years. In the presence of pain and fatigue on walking, of a positive Trendelenburg symptom, of an abnormal gait and

lordosis with adduction of the hip, the operation is indicated as a palliative measure in old congenital and pathological dislocations and pseudarthrosis of the neck of the femur.

The operation is performed under spinal anaesthesia. The osteotomy is done at the level of the ischium; an angle of 135 degrees is created between the proximal and distal fragments of the femur, and the fragments are fixed in this position with the Schanz pins. The length of fixation in plaster for unilateral osteotomy was three months; for bilateral, from four to six months. Weight-bearing in unilateral cases began five months after operation; in bilateral cases, from ten to twelve months. In several instances the osteotomy was performed on both extremities in one operation. Forty-two patients were operated on. The Trendelenburg symptom became negative in 53 per cent.; it improved in 14 per cent.; and it remained unchanged in 17 per cent.—*Emanuel B. Kaplan, M.D., New York, N. Y.*

SUR LES LÉSIONS HISTOLOGIQUES DES ARTHRITES GONOCOCCIQUES (Histological Lesions of the Gonococcal Arthritis). H. Mondor et Mlle. Gauthier-Villars. *La Presse Médicale*, XLVI, 1015, 1938.

Since 1928, the authors have collected additional data from the study of forty-eight synovial membranes, fifteen articular surfaces, and twenty-one calcaneal spurs. They have concluded that the acute gonococcal arthritides are properly osteo-arthritis. The bone invariably participates in the inflammatory process, but the synovial membrane is the predominant site of localization. Regardless of the clinical type, the gonococcus is to be found in the synovial membrane during the first eight weeks of the inflammatory process. During this acute stage, the sections are characterized by marked cellular infiltrations, mainly of the polymorphonuclear variety. As the process becomes older, the tendency towards fibrosis increases, and the cellular infiltrate becomes absorbed. The characteristic of the late stage is what appears to be a rarefaction of the underlying bone. The pathological dislocations, which are frequent, are due partly to capsular lesions, but equally to the underlying bone lesions.—*Henry Milch, M.D., New York, N. Y.*

PARALYSE RADIALE POST-SÉROTHÉRAPIQUE (Post-Serum Radial Paralysis). C. Angelesco, Alexandre N. Popovici, et I. Balutza. *La Presse Médicale*, XLVI, 1068, 1938.

Following the report of a patient in whom radial paralysis appeared from ten to eleven days after injection of antitetanus and antigangrene serum, the authors review the whole syndrome of these post-serum paralyses.

While the character of the serum seems to play some part in the development of the condition, paralysis has been noted after the use of all types of sera and even of antitoxins. The amount of serum does not seem to be of any consequence. Adults are much more often affected than are children. The paralysis may appear as early as four days or as late as three months after the use of serum, but most commonly it manifests itself within from eight to twelve days after the injections. While the paralysis may be the only symptom of the serum sickness, it is usually associated with the other signs of this complication. The onset is characterized by extreme neuralgia, which is followed at a variable interval by paralysis. Most commonly the brachial roots, and especially the fifth and sixth cervical roots, are involved, but other forms have been described. In its distribution the paralysis is "dissociated" and is not strictly radicular. It is mainly motor in nature and is accompanied by muscle atrophy, loss of tendon reflexes, and the electrical reaction of degeneration. The exact pathology and the site of the lesion are not definitely known. The prognosis must be extremely guarded. Treatment consists in the use of strychnine, massage, hydrotherapy, and electrotherapy.—*Henry Milch, M.D., New York, N. Y.*

**DE LA SYMPATHECTOMIE LOOMBO-SACRÉE DANS LES ANTÉRIORITÉS DIABÉTIQUES DES MEMBRES INTÉRIEURS** (Lumbosacral Sympathectomy in Diabetic Arteritis of the Lower Extremities). H. Chabanier, P. Gaume, et C. Lobo-Onell. *La Presse Médicale*, XLVI, 1161, 1938.

The authors report seven cases in detail. One of these appears to have been a case of thrombo-angiitis obliterans. The other six patients were true diabetics, three of whom presented signs of gangrene in the lower extremities. Of the seven patients, one died within thirty-six hours of operation; a second, apparently of insulin shock weeks after recovery from the operation. All of the other patients noted marked relief of symptoms with improvement in the circulatory supply to the affected members.

The operation which is recommended is that of abdominal resection of the lumbosacral sympathetic chain. Special stress is laid on the necessity of removing the sacral portion of the sympathetic chain. In one case, in which only the lumbar portion was excised, a second operation for the removal of the sacral chain was needed to give the desired relief. The operation is not considered excessively dangerous, even in patients sixty-eight years old, suffering from gangrene.—*Henry Milch, M.D., New York, N. Y.*

**LES GANGRÈNES DES MEMBRES D'ORIGINE VEINEUSE** (Gangrene of the Extremities of Venous Origin). M. Audier et H. Haimovici. *La Presse Médicale*, XLVI, 1403, 1938.

The authors call attention to the fact that gangrene of the extremities may occur as a result of venous thrombosis. Most commonly the gangrene is of the wet type and occurs in an oedematous leg, but cases have been reported in which dry gangrene, simulating the arterial forms, have been recorded and in which autopsy revealed thrombosis of the veins with no interference in the arterial tree. They report two cases belonging to this group. Careful autopsy of the vascular supply reveals that the arteries are intact, but the veins are extensively thrombosed and the vein walls are constantly found to be the seat of a phlebitis. Experimentally, gangrene of the extremities could be produced only after section of all the veins at the base of the thigh; simple occlusion of the larger vessels was insufficient.

The symptoms are those of gradually developing gangrene in patients with a previous history of trouble in the venous system. At the beginning of the condition, treatment should be conservative and should consist in the administration of antispasmodics, such as papaverine, and vasodilators, such as acetylcholine. Anaesthetic infiltration of the lumbar sympathetic ganglia seems to be indicated. If these methods prove ineffectual, periarterial or perivenous sympathectomy alone, or combined with a partial phlebectomy, should be attempted.

For frank gangrene, amputation alone is indicated.—*Henry Milch, M.D., New York, N. Y.*

**THE ROENTGEN DIAGNOSIS OF DESTRUCTIVE LESIONS OF THE KNEE JOINT AND ITS LIMITATIONS.** Ernst Lachmann. *Radiology*, XXXI, 521, Nov. 1938.

In this study, more than 190 artificial defects were produced in the bones entering into the formation of the knee joint in cadavera. These were of various sizes and shapes and were placed in different locations in the bones. Some of the bones were macerated before study; some were x-rayed through their normal soft-tissue coverings; others were x-rayed without these. Roentgenograms made before and after the production of the defects were studied. The defects were then filled with paraffin, with paraffin and bone detritus, and finally with a mixture of paraffin and barium, and were x-rayed and studied with each content. The defects involved cortex or spongiosa or both, and were x-rayed at various angles and tube-plate distances. Each observation was controlled by films of an untreated specimen x-rayed under identical conditions. The object of the study was to determine under what conditions defects become demonstrable in the roentgenogram.

It was found that osseous defects must be of a certain size in order to be recognized on the film. Other modifying conditions were: the diameter of the bone superimposed over the defect; the relative amount of spongiosa and cortex; the distance of the defect from the film and the tube; the relation of the central ray to the axes of the defect; and, particularly, whether or not the defect was marginal and interrupted the contour of the roentgenogram. The more complicated the outer contour of a bone, the greater are the chances that destructive foci may be overlooked.

An attempt was made to simulate the lesions produced in the knee joint by tuberculosis, osteogenic sarcoma, and osteochondritis dissecans. In regard to tuberculosis of the knee joint, the author states that in most bones, in order for decalcification to be visible, the loss of calcium must be from 20 to 40 per cent. A negative roentgenogram does not exclude the possibility of tuberculosis of a joint.

As to osteogenic sarcoma, these experiments show that there is frequently a first stage with clinical symptoms while the roentgenogram does not reveal any pathology; and that the visibility of destructive foci depends not only on their size but also on their location in spongy or cortical bone, on their margin, or the density of the tumor itself, and on the calcium content of the bone in the neighborhood. There is no individual sign which is absolutely pathognomonic for this affection.

As to osteochondritis dissecans, it is assumed that the disease may be latent for years without causing clinical symptoms. Later, the necrotic fragment is separated from its surroundings by a layer of fibrous tissue and fibrocartilage, while the articular cartilage covering it remains intact. The necrotic bone fragment now appears only slightly more dense than its environment, and its recognition depends upon the width and position of the more translucent zone of demarcation which surrounds it. Still later, the fragment becomes detached from its bed and may be anywhere in the joint cavity. It is sometimes not possible to detect the site from which the fragment originated. Even in this disease there are no absolutely pathognomonic roentgenographic signs. Other affections may, in rare cases, simulate its roentgenographic appearance.—*Edward N. Reed, M.D., Santa Monica, California.*

**CONTRIBUCIÓN AL TRATAMIENTO DE LOS QUISTES SIMPLES DE LOS HUESOS (Contribution to the Treatment of Simple Bone Cysts).** Luis A. Tamini, José Alberto Piqué, y Luis Trujillo. *Revista de Ortopedia y Traumatología*, VII, 266, 1938.

The clinical features of simple bone cysts in nine patients are summarized. The ages range from four to seventeen years. Six cysts were in the humerus, two were in the femur, and one was in the sternal end of the clavicle. A history of previous trauma was discovered in five. Therapeutic procedures described in the literature or used in the treatment of these patients are discussed. In only one of six patients with pathological fractures was the cyst cured by immobilization. Cysts of the long bones should be treated by osteotomy, curettage of the cyst, and insertion of a large graft in the medullary canal. In bones where function would not be impaired thereby, subperiosteal resection is used. From two to eight months are required for grafts to fill in the cysts.—*Edward Francis Keefe, M.D., New York, N. Y.*

**PRIMER MANUAL PARA LA REDUCCIÓN DE LAS FRACTURAS CABALGADAS DEL TERCIO ANTERIOR DEL ANTEBRAZO EN LA INFANCIA (A Manual Procedure for the Reduction of Overriding Fractures of the Lower Third of the Forearm in Children).** José Pérez Lorié. *La Revista Vida Nueva*, XLII, 335, 1938.

After a short description of this type of fracture and its symptomatology, the author outlines the technique which he has used successfully at the *Hospital Municipal de Infancia de la Habana*.

After anaesthesia of the brachial plexus, the patient is placed in the supine position with the forearm at a right angle with the arm. A strap is passed around the arm, and an

assistant holds the elbow against the table while he exerts counter-traction. Another assistant exerts continuous traction to distract the joint. Then the operator places himself so that when his thigh is flexed he will bear on the anterior aspect of the injured forearm on the most distal part of the ulna. The thenar surface of one hand rests on the dorsal surface of the distal fragment which he tries to move forward in order to angulate it with it. In the meantime, the assistant who is maintaining traction carries the patient's head and neck in extension. When the limit of hyperextension is reached, the operator helps the assistant put the hand into the hand leaning on the distal fragment. The operator then grasps the other hand, supported by the hand leaning on the distal fragment, and begins to displace the fragment forward. In most cases a snapping sound indicates that the reduction has been successful. The forearm and hand are then immobilized in a double splint without padding.

The author has used this method in six of ten cases. In all but one case the reduction was successful, and the functional and cosmetic results were perfect.

L'INFLUENCE DES TROUBLIS DE LA CIRCULATION SUR LA CROISSANCE DES OS EN LONGEUR. ÉTUDE EXPÉRIMENTALE. (Experiment and Study of the Influence of Interference with the Blood Supply on the Growth in Length of Bones.) Sousa Pereira. *Revue d'Orthopédie et de Chirurgie de l'Appareil Moteur*, XXV, 140, 1938.

In a series of young rabbits from six to eight weeks old, the author sectioned and ligated the principal arteries and veins in the upper thigh and found that this did not interfere with the growth of the bones of the extremities. In others, he also elevated the periosteum from the shaft and found no interference with growth. In still others, he stripped up the periosteum of the shaft and of both epiphyses of the ulna and found that in some instances there was decrease of growth in length. From his observations, he concludes that (1) in order to obtain a disturbance in growth in length of a bone, there must be a profound interference with the circulation, not only of the entire diaphysis, but of the epiphyseal cartilage plates, which can be obtained only by removing the periosteum from both of these areas; and (2) the perichondrium is more important in the nutrition of the bone than is the periosteum.—J. Albert Key, M.D., St. Louis, Missouri.

L'ISCHIONITE—ACROSTÉALGIE HOMOLOGUE DE LA CORACOIDITE (Ischionitis. An Acrostealgia Homologous to Coracoiditis). Théo. Marti. *Revue d'Orthopédie et de Chirurgie de l'Appareil Moteur*, XXV, 289, 1938.

Bonneau grouped all types of inflammation of the tuberosities and of the apophyses under a collective name of "acrostealgia". These are produced by a sudden or continuous traumatic traction on a muscle group attached to a bony prominence. The author isolates a definite clinical entity which he names "ischionitis", and which, as the name implies, is limited to the ischial region. Four cases are described and are followed by a complete analysis of the pathogenesis, diagnosis, and treatment.—Emanuel Kaplan, M.D., New York, N. Y.

FRACTURE SPONTANÉE PAR OSTÉOMYELITE SIMULANT UN SARCOME (Spontaneous Fracture in Osteomyelitis Resembling a Sarcoma). DeLangre et Crétin. *Revue d'Orthopédie et de Chirurgie de l'Appareil Moteur*, XXV, 320, 1938.

The authors present the case of a man forty-eight years of age, who entered the hospital with a diagnosis of osteogenic sarcoma of the right femur following a spontaneous fracture. The symptoms consisted of pain and swelling of the lateral surface of the thigh of a month's duration. The temperature had been normal. On admission, there was marked deformity of the thigh with a hard, resistant swelling, without signs of inflammation and with no fluctuation. The superficial veins were dilated, but the skin appeared

normal. The patient was very anaemic, and the temperature was 38 degrees Centigrade. Roentgenograms showed a fracture of the upper third of the femur with marked rarefaction of the bone and some subperiosteal new bone formation on the mesial aspect. Eight days after admission, under spinal anaesthesia, a disarticulation at the hip joint was performed. During the operation an abscess was opened in the adductor muscles. The patient was in shock after the operation and was given a blood transfusion. The wound suppurred. Seven days later the patient died suddenly. Autopsy failed to disclose the cause of death. Examination of the specimen showed typical destructive osteomyelitis without evidence of malignancy, and a staphylococcus was obtained on culture.

The authors emphasize the fact that, while this tumefactive type of osteomyelitis is rare, it may occur without fever and without sequestra and may resemble very closely a rapidly growing bone sarcoma.—*J. Albert Key, M.D., St. Louis, Missouri.*

**EXPERIENCES WITH METAPHYSEAL GROWTH ARRESTS.** J. Warren White and W. P. Warner, Jr. *Southern Medical Journal*, XXXI, 411, 1938.

Leg-lengthening and leg-shortening operations are difficult and not always entirely satisfactory. Phemister introduced the plan of arresting the growth in length of the leg by causing a premature union of the growth epiphysis to the diaphysis of the long bones. This operation is limited to children who have a growth expectancy of several years' duration.

The authors describe a chisel which they use to shorten the procedure, and give in detail the operative technique. The distal epiphysis of the femur is approached through two longitudinal incisions,—one lateral, the other medial. A tourniquet is used. The periosteum is pushed aside, and a bone plug, half an inch square, is cut out for a depth of three-quarters of an inch on each side. The remaining cartilage is curetted out. The plug is then rotated 90 degrees and replaced. This gives a bone graft across the epiphyseal line. A light plaster cast is used for two weeks, followed by physiotherapy.

This operation has been done by the authors in fifty-seven cases. In twenty-eight of these cases, the shortening was due to anterior poliomyelitis. The operation may also be done on other epiphyses to obtain greater shortening.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

**ANATOMICAL AND FUNCTIONAL RESULTS IN FRACTURES OF THE PELVIS.** P. Walter Carruthers. *Southern Medical Journal*, XXXI, 451, 1938.

The author states that the goal of treatment of fractures of the pelvis is the restoration of anatomical position and function. The application of plaster-of-Paris to both lower extremities with the incorporation of three turnbuckles to act as levers (Jahss's method) is a valuable aid in restoring the width of the pelvic outlet in females. A well-leg traction splint can be used to help in realignment. As near perfect reduction as possible should be secured and maintained.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

**OSTEOSYNTHESIS IN THE PRESENCE OF METALS. STUDIES ON ELECTROLYSIS.** Charles S. Venable. *Southern Medical Journal*, XXXI, 501, 1938.

The author and his coworkers decided that much of the trouble encountered in the use of metal plates, screws, nails, etc., in bone surgery was due to electrolytic action. An alloy known as vitallium was found to be non-corrosive in body fluids, neutral in electrical reaction, non-irritating, and possessing rigidity and strength. Experiments were made with various types of steel, duraluminum, Dow metal, and vitallium. Experiments *in vitro*, using salt solution, and *in vivo*, using rabbits, showed vitallium to be the only metal which was ideal for bone fixation. Vitallium screws, plates, nails, etc., were then used clinically for the fixation of the fractures, and in old cases of non-union, with very satisfactory results.—*F. G. Hodgson, M.D., Atlanta, Georgia.*

**MAGNESIUM SCREW AND NAIL FIXATION IN FRACTURES.** Earl D McBride. *Southern Medical Journal*, XXXI, 505, 1938

Magnesium plates have been used in bone surgery since 1906. The advantage of magnesium is that it is absorbable. Unfavorable results, due to gas formation and sloughing, have been reported. The metal which the author used in his series of cases consisted of 95.7 per cent. magnesium with 1 per cent aluminum and 0.3 per cent manganese. The author shows various types and sizes of screws, bolts, pegs, and nails, which can be made from this metal.

Following reduction of the fracture, the fragments are held by bone clamps. The holes are drilled, and screws or nails are firmly implanted. Plates or intramedullary pegs are not used.

The author states that the magnesium alloy was employed for fixation in twenty cases. Non-union occurred in one case. In seven cases, magnesium screws were used to fix bone grafts. Gas formation occurred in some of the cases. The metal screws were entirely absorbed in from three to seven weeks as shown by roentgenograms. Firm union usually occurred in about the normal time. Magnesium metal should not be used with other metals because of electrolysis.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

**DISPLACEMENT OF THE INTERVERTEBRAL CARTILAGE AS A CAUSE OF BACK PAIN AND SCIATICA.** Edgar F. Fincher and Elwin B. Walker. *Southern Medical Journal*, XXXI, 520, 1938.

The most common symptom is pain. The pain may quiet down, followed by acute exacerbations. It is located usually in the low back and may radiate to the hip joint, down the back of the thigh, into the calf of the leg, or the outer side of the foot. It may be unilateral or bilateral. Patients are usually more comfortable when lying down. The location of the lesion in the spine cannot usually be definitely determined by the location of the pain.

Muscle spasm and limitation of motion are often present. There may be listing of the body toward or away from the painful side. Straight-leg raising is frequently limited on the painful side.

Neurological examination may be negative, but in the majority of the cases there is some persistently positive finding. Variation in normal reflexes and sensory disturbances may be found. Motor disturbance is rare.

Roentgenographic studies of the spine and complete spinal-fluid examinations are necessary. A positive Queckenstedt sign is rare. Roentgenographic studies, following the injection of five cubic centimeters of iodized oil, are necessary for definite location of the lesion. Fluoroscopic studies are made on a tilting table and films are made immediately and studied for details.

The treatment is surgical. Decompression alone does not relieve these cases. Removal of the herniated portion of the disc is necessary. Unilateral laminectomy is usually sufficient, but in centrally located lesions bilateral laminectomy is performed. The wound is closed without drainage.—*F. G. Hodgson, M.D., Atlanta, Georgia.*

**RUPTURE OF BICEPS BRACHII. REPORT OF 14 CASES.** Richey L. Waugh. *Southern Medical Journal*, XXXI, 619, 1938

Seven of the fourteen cases reported were due to indirect trauma, and four were due to direct trauma. In three of the cases, the Wassermann test was positive. Twelve of the fourteen patients were operated upon.

The signs, symptoms, and diagnosis are discussed. The author believes that early suture gives the best results. The treatment of older cases depends upon the amount of disability present. In cases of rupture at musculotendinous junctions or of the lower tendon, a fascial transplant may be necessary.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

**THE MANAGEMENT OF COMPOUND FRACTURES.** Guy A. Caldwell. *Southern Medical Journal*, XXXI, 746, 1938.

This is a very clear and concise discussion of the subject, an excellent abstract of which is contained in the author's summary:

"1. An accurate history and careful inspection of the wounds yield valuable data with regard to probable contamination with anaerobic organism.

2. No operative procedure should be done until the effects of shock and hemorrhage have been overcome.

3. The time interval from injury to operation is of great importance.

4. Thorough débridement demands skill and judgment; it is far more than simple excision of wound margins.

5. Reduction of the fracture through the wound should be done only in simpler cases.

6. Internal fixation with screws or plates has a very limited field of application, but is permissible in this field.

7. Suture of the wound is never altogether safe; it certainly is not essential to recovery and a very few surgeons with ripe experience in compound-fracture treatment are the only ones who should venture to close the wounds in selected cases.

8. Dressings should be loosely inserted.

9. Splinting is a different problem with every case and the solution must vary with the experience of the surgeon in the use of various splinting methods."—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

#### ORTHOPEDIC PARTICIPATION IN A PUBLIC PROGRAM OF CARE FOR CRIPPLED CHILDREN.

Allen F. Voshell. *Southern Medical Journal*, XXXI, 1029, Sept. 1938.

This is a description of the work being carried on in the United States under the provisions of the Social Security Act approved on August 14, 1935. This is a permanent Federal program of medical care based on the principles of (1) Federal grants-in-aid to the states, and (2) cooperation with medical groups and other organizations having closely related interests. Federal grants are matched by equal funds from the states and a single official state agency will administer the plan after approval by the Chief of the Children's Bureau. The Advisory Committee recommends only qualified personnel for services for crippled children:

1. Only surgeons who are certified by the American Board of Orthopaedic Surgery or who are eligible for such certification;

2. Consultant physicians or surgeons who are certified by the National Board of their specialties;

3. Only registered physical-therapy technicians;

4 and 5. Qualified and registered nurses and social workers;

6. Qualified hospitals.

Physicians and surgeons rendering services are to receive remuneration, the amount to be worked out jointly by the state agency and a committee from the state medical society. The hospitals are paid a *per-diem* rate for the care of the children. Education, vocational training, placement, and social readjustment are provided for.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

#### THE OBSTETRICAL SHOULDER TRAUMA.

Oscar Seaglietti. *Surgery, Gynecology and Obstetrics*, LXVI, 868, 1938.

The writer differentiates between obstetrical shoulder trauma and obstetrical paralysis, the former occurring almost three times as frequently in eighty-four cases. He states that 55.27 per cent. of the cases occur in males; 93.46 per cent. are unilateral; and 62.81 per cent. involve the right side. The lesion is always acquired during delivery.

The early clinical picture is functional disability and internal-rotation contracture. The first roentgenographic evidence is formation of perosteal callus. After the appearance of the epiphysis, which is late, the degree of epiphysiolysis can be determined. If there is no displacement, the prognosis for no deformity is good. The writer thinks that in most cases with displacement and subsequent deformity there is a fracture through the cartilaginous epiphysis.

The sequelae of the birth injury are internal rotation, slight abduction contractures and shortening of the upper extremity, and change in shoulder configuration. The head of the humerus is felt displaced backward. The capsule is contracted. The roentgenographic appearance is typical. The epiphysis is constantly displaced posteriorly (increasing the angle of declination) and laterally. The bony nucleus is deformed, but after the age of three tends to correct its position. The metiphysis, glenoid, and clavicle may show changes. The primary cause of the internal rotation is the defense position assumed by the newborn with secondary contractures taking place.

The treatment is conservative for patients under two years of age,—that is, abduction and external rotation, application of shoulder spicae and braces, followed by physical therapy. In patients over two years, the sever operation alone is done, but in cases where retroversion is more than mild the addition osteotomy or Putti is necessary. The article is well illustrated.—Richard McGovney, M.D., Santa Barbara, California.

**HALLUX VALGUS.** Harry C. Stein. *Surgery, Gynecology and Obstetrics*, LXVI, 889, 1938.

Anatomical and physiological details of the role of the sesamoids are especially considered. The etiology of the deformity is a functional postural adaptation later becoming structural in character. The sesamoids move with the position of the great toe because of their presence in the tendons of the flexor hallucis brevis. The attachment of the adductor obliquus hallucis tendon to the outer margin of the lateral sesamoid is the important factor. The importance of the position and action of the abductor hallucis tendon is discussed. This tendon migrates inferiorly and laterally, causing an evertting and flexing action on the hallux and losing its splinting action on the first metatarsal head. The bony component of the enlargement on the mesial side of the joint is relatively small as compared to the fibrocartilaginous capsule and bursal sac.

The surgical indications are the division of the contracted deforming structures on the lateral aspect, a bursectomy, and capsuloplasty on the mesial aspect with removal of obstructing bone. The author's operation to meet these requirements is described in detail.

Postoperative weight-bearing is allowed in two weeks. A night splint is worn for several months. Exercises and proper shoes are mentioned. Fifteen patients have been operated upon since 1933 with satisfactory results. The article is profusely illustrated.—Richard McGovney, M.D., Santa Barbara, California.

**SKELETAL DISTRACTION OF THE TIBIA.** David M. Bosworth. *Surgery, Gynecology and Obstetrics*, LXVI, 912, 1938.

This is an extremely interesting and well-written article on leg lengthening, with a wealth of personal experience. The four principles which are essential for successful lengthening may be summed up as follows: bipolar positive skeletal distraction without joint interposition, with the lengthening force gradually applied to both ends of complete transfixation pins over a considerable period of time, and maintenance long enough following lengthening for solid union to occur.

The apparatus consists of two side bars with key-operated ratchets, a drill guide, and pins. When the bars are locked to the pins, there is absolute rigidity. Deviations of alignment can be prevented or corrected simply.

The Achilles tendon is lengthened and the pins are inserted. The distal pin is

inserted first; the pin next to the top, last to allow it to be offset one-fourth of an inch anteriorly to prevent anterior angulation of the tongue of the proximal fragment. Parallel motor-saw cuts are made in the tibia and are joined above posteriorly and below anteriorly. A single fibular osteotomy is done through the same incision. It is not necessary to divide the leg fascia; no deep sutures are used. Pins and incisions are dressed with gauze moistened with Dakin's solution.

Lengthening should never be started until wounds are healed, usually the tenth day and then lengthening of only one-tenth to one-eighth of an inch every other day should be done. In adults, bone grafting is necessary to fill in the upper defect. When the desired lengthening has been obtained, the pin in the os calcis is removed and a plaster cast, incorporating the other pins, is applied before the side arms are removed.

Nineteen of twenty-four cases treated by this method are reported. The length gained ranged from one and one-fourth to three and one-half inches. Only three infections occurred,—two in cases in which lengthening was started too early and one in a case in which buried sutures were used. Postoperative pain was not a complication. The pins remained *in situ* on an average of four months with very little pin-hole irritation. Damage to the joint structures was unusual, and slight if present. Children were ambulatory in six months; adults, in twelve months or more. Eversion, pes cavus, and hammer toes did not persist. No neurocirculatory complications were encountered. There were no mortalities, losses of extremities, or failures to gain and to maintain length.—

*Richard McGovney, M.D., Santa Barbara, California.*

#### A NEW SURGICAL PROCEDURE IN ACUTE INFECTIOUS ARTHRITIS. PRELIMINARY REPORT.

Herbert E. Hipp. *Texas State Journal of Medicine*, XXXIV, 276, 1938.

A new surgical procedure for the treatment of acute infectious arthritis is presented in this paper. The method is applicable only to the type of acute arthritis commonly due to streptococci or to gonococci; purulent arthritis from penetrating wounds or from a spreading hematogenous osteomyelitis is not considered.

The author has observed many cases of acute infectious arthritis preceded by, or associated with, pain due to an osteoperiostitis of the calcaneum at the attachment of the plantar fascia. This finding was evident in 64 per cent. of the 137 cases studied. Surgical exposure was made at this site, and in early cases it was frequently found that streptococci could be cultured from the material removed.

These results suggested that acute infectious arthritis might develop primarily as a subchondral osteitis and invade the joint through the joint cartilage rather than by way of a primary synovitis. Therefore, multiple drillings of the subchondral and immediately adjacent regions of affected joints were done in sixteen cases. A serosanguineous exudate was found in every instance. In 43 per cent. of the cases streptococci were cultured from the exudate. Practically all of the cases occurred in the acute or relatively early stages of the disease. In each of these cases with positive cultures an excellent end result was obtained.

A drill, having a diameter of from one-quarter to three-eighths of an inch, is used. Precautions must be taken not to penetrate the joint cartilage and to observe a strict aseptic technique. In children the epiphyseal cartilage plate must not be drilled through or traumatized. General anesthesia is used, and the joint is immediately immobilized by means of a plaster casting.—*H. M. Childress, M.D., Chicago, Illinois.*

#### Note

In connection with the abstract of the article entitled "Another Method of Pinning Fractures of the Neck of the Femur", by Dr. Joseph Madison Greer, published in the October issue (page 1099), *The Journal* wishes to call attention to the fact that the screw used by Dr. Greer was designed by Dr. Robert K. Lippmann, of New York City.

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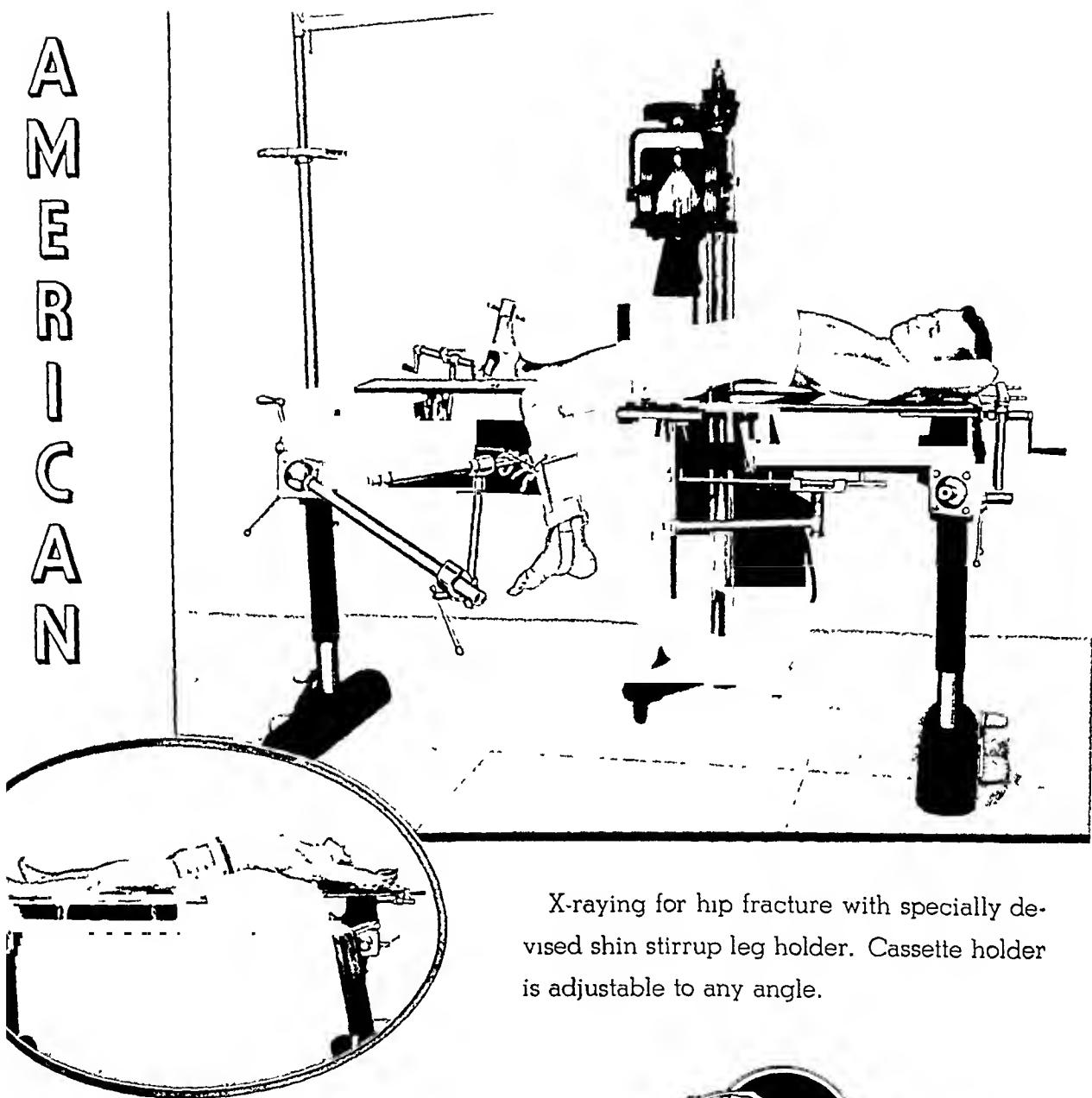
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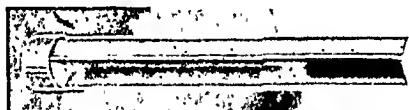
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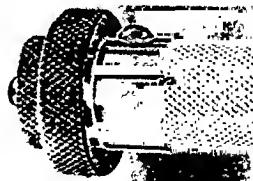
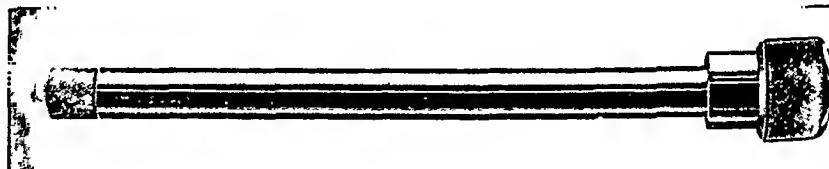
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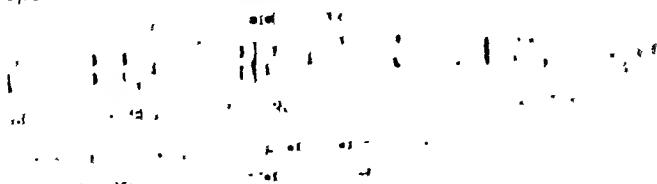
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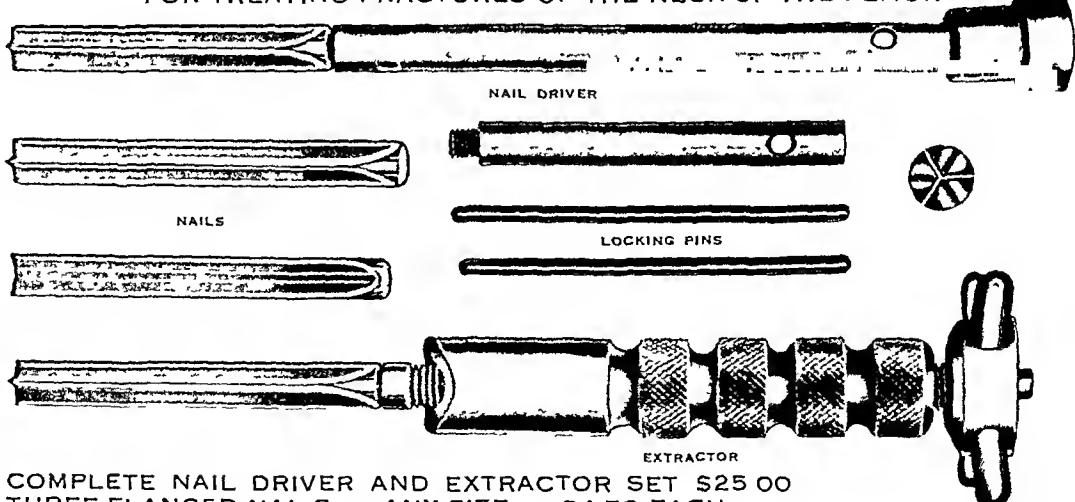
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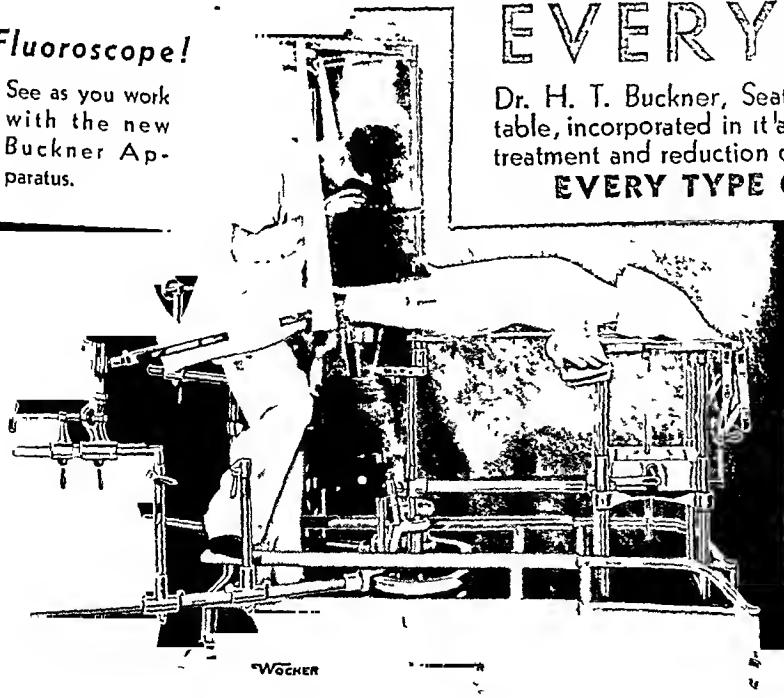
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